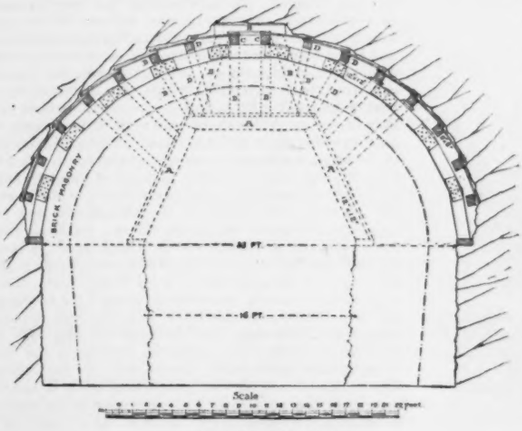
Widening a Tunnel on the S. V. R. R.

The St. Clair Tunnel, on the Schuylkill Valley branch of the Pennsylvania R. R., near Pottsville, Pa., was first projected for single-track and driven on this basis for nearly its entire length of 800 feet. A change of plan caused the widening of the tunnel to double-track dimensions, and the following description of the method pursued was obtained in a personal interview with Mr. Michael Nolan, under whose direction the work was projected and carried out.

The material penetrated was the usual coal formation of the Pottsville region, made up of slate, shale, loose rock and coal. The single-track tunnel was already driven and timbered with 12 by 12 inch sticks, as shown at *A A A* in the figure. The widening operations were commenced by driving a top-heading shown at *B B B*, with dimensions of about 6 by 6 feet and timbered with 12 by 12-inch sticks resting upon and continuing the lines of the original



Tunnel Widening.

set. Then the longitudinal timbers *C C* were put in place and temporarily propped from the caps *A* by the sticks *D D*. This being done, the heading was widened towards each haunch equally and the side-posts *B B* removed.

As this widening was carried out further, 8 by 8-inch longitudinals, 16 feet long, were put in and covered by poling-boards following the intended curve of the double-track tunnel. These longitudinals were braced from the single-track tunnel sets by the props *D'. D'.*, both sides being carried out equally so as to prevent shoving. This system was carried out until the springing line was reached on both sides as shown.

An 8 by 12-inch wall-plate, 12 feet long, was then put in position, and upon this was started the framed timber, arch made of segments of 12 by 12-inch pieces, each about 4 feet 2½ inches long, and with joints cut on the radial lines. When this arch was keyed in, the props were removed which held the longitudinal stringers, and wherever necessary these latter were wedged between them and the arch ribs. Each 12-foot wall-plate carried four of these ribs, and the only sheeting required was that used in enlarging the tunnel originally.

With the arch-ribs in place for one section of 12 feet the timbers of the single-track tunnel were removed and the tunnel widened below the springing-line and the permanent lining masonry at once started.

Although the ground was heavy and treacherous, the widening was successfully and rapidly carried out, and the masonry is now being built.

Municipal Engineering; Paper No. 3.*

WASHINGTON, D. C.

(*Concluded from Page 270.*)

Health Department.

The health department of the District of Columbia is organized under the following Act of Congress.

"The Commissioners of the District of Columbia shall appoint a physician or health officer, whose duties shall be under the direction of said Commissioners, to execute and enforce all laws and regulations relating to the public health and vital statistics." The law further provides that there may be appointed by the Commissioners of the District of Columbia, on the recommendation of the health officer, a reasonable number of sanitary inspectors for said District, not exceeding six, of whom two may be physicians, and one shall be a person skilled in the materials of drainage and ventilation. The officers of this department as now organized consist of the "health officer, one chief and four assistant clerks, six sanitary inspectors, one inspector of plumbing, one assistant inspector of plumbing three food inspectors, one inspector of marine products, one pound-master, one messenger, and eleven physicians to the poor."

The health officer is charged with the abating of nuisances, inspections of all articles of food offered for sale; impounding of animals found running at large, including unlicensed dogs; the removal of dead animals, garbage, and night-soil, the treatment of indigent sick, and keeping of vital statistics and the inspection of plumbing.

The only branches of this department which are of especial interest to engineers are the removal of garbage, etc., already treated of, and the inspection of plumbing, the regulations inregard to which are given below.

Regulations governing Plumbing, House Drainage and the Ventilation of House Sewers.

These regulations are authorized under an Act of Congress, approved January 25, 1881, and amended by the District Commissioners under date of November 17, 1882.

The Inspector of Plumbing, under the direction of the Health Officer, must sign and issue all notices, inspect all houses in course of erection, alteration or repairs, and see that all plumbing, drainage and sewerage work is done in accordance with the provisions of the "regulations." The Inspector must give a bond of $5,000 for the faithful performance of his duties.

Any person doing business as a plumber, or conducting it as a business, must be registered at the Health Department and give a bond for $500 conditioned upon the full observance of the "regulations."

Before doing any drainage work for a building the plans of such system from its connection with main sewer terminus in the house together with the location of all traps, ventilating pipes, etc., must first be filed with the Health Officer. The name of the plumber who is to do the work must also be approved by this officer before a permit to construct will be granted. This permit is required for *all* connections with water, sewer or gas mains. Whether the sewer involved is on private property or in the public street. Plumbers must also notify the Engineer Commissioner of all alterations in water fixtures or pipes made by them. The permit fee is $1.00 for each house connected, paid to the collector of the District of Columbia.

All sewer connections must be inspected before the trench is filled up. All connections with pipe sewers must be by a Y branch, with a brick sewer by a terra-cotta junction block. These branches and junction blocks must be purchased from the District. Pipe sewers must not be cut nor a connection made with a manhole, trap or lateral. Each house must be drained by a separate drain not less than 6 inches in diameter, having a fall of not less than 1 in 40, and if the drain is terra-cotta it must be laid on a hydraulic cement concrete foundation 4-inches thick.

All concrete pavements must be repaired by the contractor doing such work for the District, and all granite block pavement by the Superintendent of Repairs, at rates fixed by the Commissioners. Any person desiring to break a concrete or granite pavement must first deposit with the Engineer Department the estimated cost of repairing the same; and he must do this and exhibit his receipt before he can get a permit. After repairs, any surplus over actual cost is returned to the householder.

All permits for tapping sewers are conditioned that the owner takes the risk of back-flow from the main sewers; and whenever necessary the owner is required to insert at his own expense a self-acting or other valve to prevent this action. All sewer trenches must be filled up, thoroughly puddled and rammed within forty-eight hours after making connection and the pavement must be relaid in twenty days to the satisfaction of the Commissioners, so that no settling shall occur.

A running trap must be placed on every main drain at an accessible point, with a manhole and iron cover over it. Every drain must have a fresh-air inlet on the house-side of the trap.

All pipe used underground must not be less in weight than as follows:

6-inch Pipe,	20	pounds	per	lineal	foot
5-inch "	17	"	"	"	"
4-inch "	13	"	"	"	"
3-inch "	9¼	"	"	"	"
2-inch "	5⅝	"	"	"	"

Every soil, drain or waste pipe inside of the building line and 5 feet exterior thereto must be of iron coated inside and out with coal tar applied hot.

THERE are yet on our shelves a few copies of the "Second Issue" of "Statistical Tables of American Water-Works." We will be obliged for the address of any water-works' office in the United States or Canada to which a copy has not been sent free by us in return for information. We guarantee to advertisers that a free copy shall be placed in each office listed, and we not only do so, but we have freely distributed them wherever we thought they would be of use in promoting the construction of new works. If any failure to receive the books has occurred, we want to know of it promptly.

NOTES OF FOREIGN RAILROADS.—The German promoters of railroad schemes in China report from Pekin that the Chinese Government has replied that it does not intend to build railroads until China can manufacturer all the rolling-stock required. It is rumored that negotiations are on foot by China for a $50,000,000 loan for the purpose of building railroads.—The Dutch Government has asked a credit of $1,400,000 for the construction of a railroad in its East Indian colony from Tjitjalengka to Tjilatjap, with a branch to Garaet. The whole line is expected to be finished in four or five years at a cost of $7,800,000.

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The Gate House of the New Croton Aqueduct.

The illustrations given herewith show an elevation, plan, and sectional view of the gate house of the New Croton Aqueduct, soon to be put under contract. This gate house will be located on the southwest corner of 105th street and Convent avenue, on rising ground just north of Manhattan valley, and will be the city terminus of the aqueduct now under construction.

Fig. 1 shows a perspective view of the building as completed, the material used being granite. Fig. 2 is a plan of the water-chambers and gateways; these will be faced with granite, with brick used in the stop cock or gate-chambers on the south side of the main chamber and also for the vertical portion of the aqueduct inlet; rubble masonry will be employed generally as backing in the walls of the substructure.

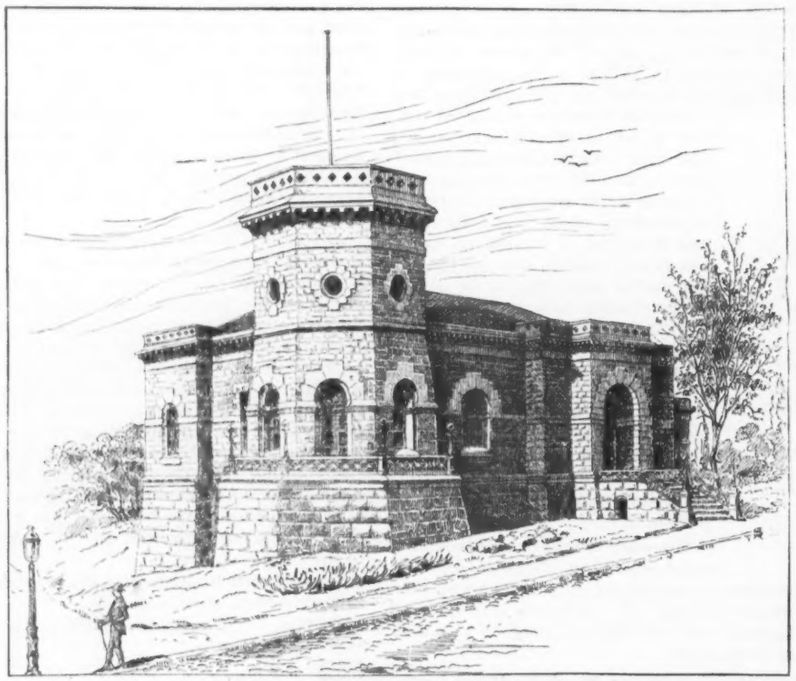


Fig. 1.—Perspective View of the Gate House. New Croton Aqueduct.

The plan (Fig. 2) shows two main water compartments; the larger one taking the water directly from the aqueduct shaft, shown in the center of the octagonal tower and rising about 40 feet above the aqueduct proper. Alongside this first compartment, or south of it, are eight other compartments fitted with grooves to receive screens, or stop-planks. From these secondary chambers the water passes through a slide gate in each into the eight 48-inch mains, which latter pass through the third set of chambers shown and are there each provided with a stop-cock valve. This general arrangement is better shown in the sectional view, Fig. 3. Four of these mains conduct the water to the Central Park reservoir, and the other four discharge directly into the city distribution at points along the route of the first four.

In the first chamber of the gate house the water will stand at a depth of about 40 feet; and a 10-foot circular conduit (see Fig. 2) will connect the new with the present gate house and pipe line on Tenth avenue. In the entrance chamber to this conduit the water will be about 20 feet deep, and the chamber is provided with four gates raised and lowered, like all the others, by hoisting machinery on the floor above connected with the gates by rods. The stop-cocks will be manipulated from platforms below (Fig. 3) connected together by a circular passage-way. Channels arranged in the masonry convey to the sewers any water working through the walls, and thus prevent any leakage showing itself on the outer walls.

These water chambers will be faced with cut granite laid in hydraulic cement, with a ¾-inch joint caulked on the face with neat cement. The paving in these chambers will be 18 inches deep, with the same kind of joint as in the facing and laid in hydraulic cement mortar on a concrete base.

The excavation for the foundation is in rock for about 20 feet, and the depth adopted is for the purpose of so arranging this terminal station that it shall be low enough to drain the water from the bottom of any reservoir that may be located in the upper part of the city into the Central Park Reservoir.

The building itself will be about 30 feet high and the tower 50 feet; the top of the tower will be at an elevation of about 170 feet above tide-level, affording an unsurpassed view of the Manhattan valley and the City of New York generally. The exterior of the gate house will be built of granite of contrasting shades, with fine hammer-dressed light granite trimmings. The interior will be lined with red, buff and black pressed brick, arranged with a view to decorative effect. The roof will be made of iron trusses covered with slate laid in mortar; the gutters and flashings will be copper.

The cost of the structure in complete working order is estimated at $250,000, and it is to be completed on or before September 30, 1887. The building was designed by Mr. F. S. Cook, Assistant Engineer in charge of the draughting department, under the direction of the Chief Engineer.

The amount of water to be passed through this gate house, with the new aqueduct running to its full capacity, will be 250,000,000 gallons daily—and it can't come too soon.

IRRIGATION.—The Surface Ditch & Reservoir Company has been incorporated at Denver, Col. Capital stock, $30 000. The incorporators are J. W. Steel, W. Alexander, H. E. Kennicutt, and others.

On Some Points for the Consideration of English Engineers with Reference to the Design of Girder Bridges.*

BY W. SHELFORD, M. I. C. E., AND A. H. SHIELD, ASSOCIATION M. I. C. E.

Engineers with an eye for bridge-building cannot fail to be struck by the difference in general appearance between English, German and American bridges. The ordinary plate girder unquestionably finds more favor in England than elsewhere, while in Germany it seems to have been more or less discarded in modern practice, and is replaced by lighter structures, designed with a more scientific disposition of the material, and constructed chiefly of angle and bar iron. Both in Germany and America the modern practice appears to adopt large panels and great depth—a system of construction which has been greatly facilitated by the use of steel, owing to the greater length of the bars and plates procurable in that metal, and the consequent diminution in the number of joints. In America also, pin-jointed bridges are the rule, and riveted joints the exception—exactly the reverse, in fact, of the English practice—and the deep pin and link truss, with a straight top boom and long panels, there almost the universal method of construction for spans over 75 feet, differ in a striking manner from both English and German bridges. Its construction has been brought to considerable perfection, and appears to be eminently suitable for a country where distances are great, and labor scarce and expensive and rapid construction of the utmost importance. By this system the Americans are able to turn out a bridge with the greatest accuracy and expedition, and can erect it without previous erection in the shops, and with little staging, in an incredibly short space of time. In England, on the other hand, a strong bias among engineers in favor of riveted joints has led to the absence of special appliances for the manufacture of pin and link bridges; and the practical advantages of the system are less esteemed, as English engineers do not push forward their railways so rapidly as the Americans. As most English railway engineers must now look chiefly to the development of new countries for future work, these general facts should be sufficient ground for an examination of their practice; but if more definite reasons are sought, reference may be made to the case of Canada, where English engineers who built the first bridges have since been superceded by Americans. The design of a bridge of exceptional span is almost invariably the subject of special study to an extent which is inadmissible in the case of bridges of ordinary size. These are usually constructed in accordance with a limited number of standard types, which experience has shown to be suitable, and it is to these only that such general considerations as have been suggested properly apply. The economic importance of smaller bridges is also greater, and it is to bridges of spans less than 200 feet which, with reference to the American system, may be termed merchantable sizes, that the scope of this paper is therefore limited. In order to ascertain the extent to which the weight of bridges of an ordinary span is affected by their design, seven designs were chosen for bridges of 140 feet span, for a double line of railway. The designs were selected to represent leading English and American types, and their strength was determined by a rolling load of 1½ tons per lineal foot for each track. The weights of the bridges were estimated, including plate flooring, rail bearers, and cross girders, and the necessary stiffening or bracing for wind pressure. The design of the bridges with their estimated weight is shown upon the diagram:—No. 1 is a riveted bridge of what is usually known as the "N" type, with panels of a length of 8 feet, which has been generally accepted a affording an economical floor, and a depth of 12 feet, or one-twelfth span. Its weight is 190 tons. No. 2 is a bowstring girder of a similar length of panel, but with a depth at the center of 18 feet. Its weight is 181 tons. Both these bridges derive lateral stiffness entirely from the plate floor, and owe their transverse stability to the connection of the verticals to the cross girders by knee pieces, aided in the case of the bowstring girders by light overhead stays at the center. Nos. 3 and 4 afford a greater depth with a similar length of panel, by introducing in No. 3 a double system of bracing, and in No. 4 by suspending alternate cross girders from the upper panel points. Their depth is 18 feet, and admits of a complete system of lateral bracing between the top booms, so that the transverse stiffening is confined to the ends. No. 3 is designed for pin connections throughout, and its weight is estimated at 175 tons. No. 4 is designed for pin connections in the lower chord only, and its weight is estimated at 169 tons. The relative advantages of these two types is discussed at length by Mr. C. Bender in his recent book on "The Economy of Metallic Bridges," and preference is given

*Paper read before Section G of the British Association at Birmingham.

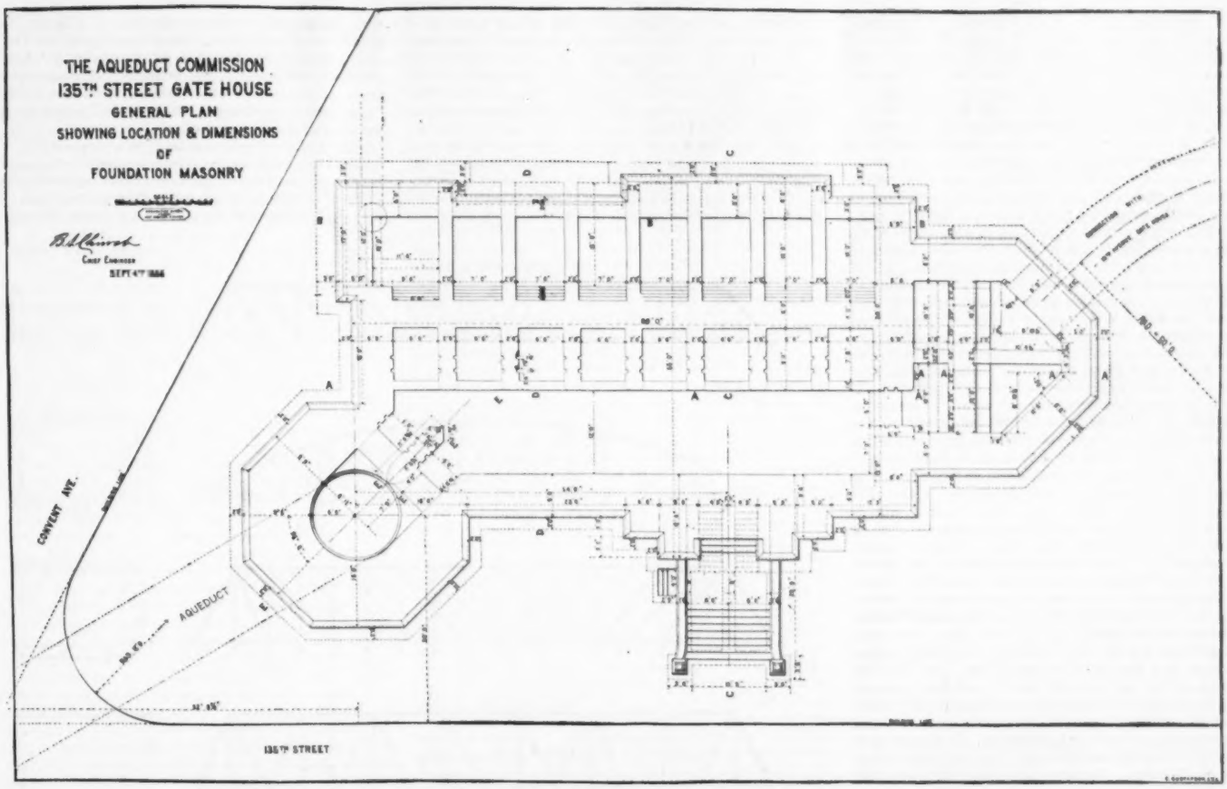


Fig. 2.—Plan; Gate House. New Croton Aqueduct.

by him to No. 3. No. 5 is an ordinary type of American bridge, with a depth of 24 feet and panels 17 feet 6 inches long. The lateral stiffness of the bottom is derived from the plated floor. It has top lateral bracing and transverse stiffening at the ends, as in Nos. 3 and 4. It is designed for pin connections throughout, and its weights estimated at 156 tons. No. 6 represents an attempt to apply to the conditions of the problem the principles enunciated by Mr. Max am Ende in a paper recently read before the Institution of Civil Engineers. It is a polygonal girder, with panels 20 feet long and a maximum depth of 26 feet 3 inches. Lateral stiffness is derived entirely from the floor, and transverse stiffness is obtained by combining each of the cross girders with the vertical and overhead stays into a rigid frame. Its weight is estimated at 154 tons, designed throughout for riveted joints. No. 7 was suggested by the central span of the Niagara cantilever bridge, and has panels of 24 feet, with a depth of 24 feet and a wind system similar to that of Nos. 3, 4 and 5. Like No. 5, it is designed for pin connections, and its weight is estimated at 156 tons. Plate floors have been used throughout these designs, in order to enable a comparison to be made between the weights, although in America they would be replaced by heavy timber decks, with diagonal bracing of iron rods. From these examples it will be seen that the difference in weight of good designs of the same depth is comparatively trifling, and is not greater than might be compensated by local considerations, such as the relative cost of labor and material, facilities for erection, and the difference in cost of various methods of construction, while the fundamental principal that the weight of a

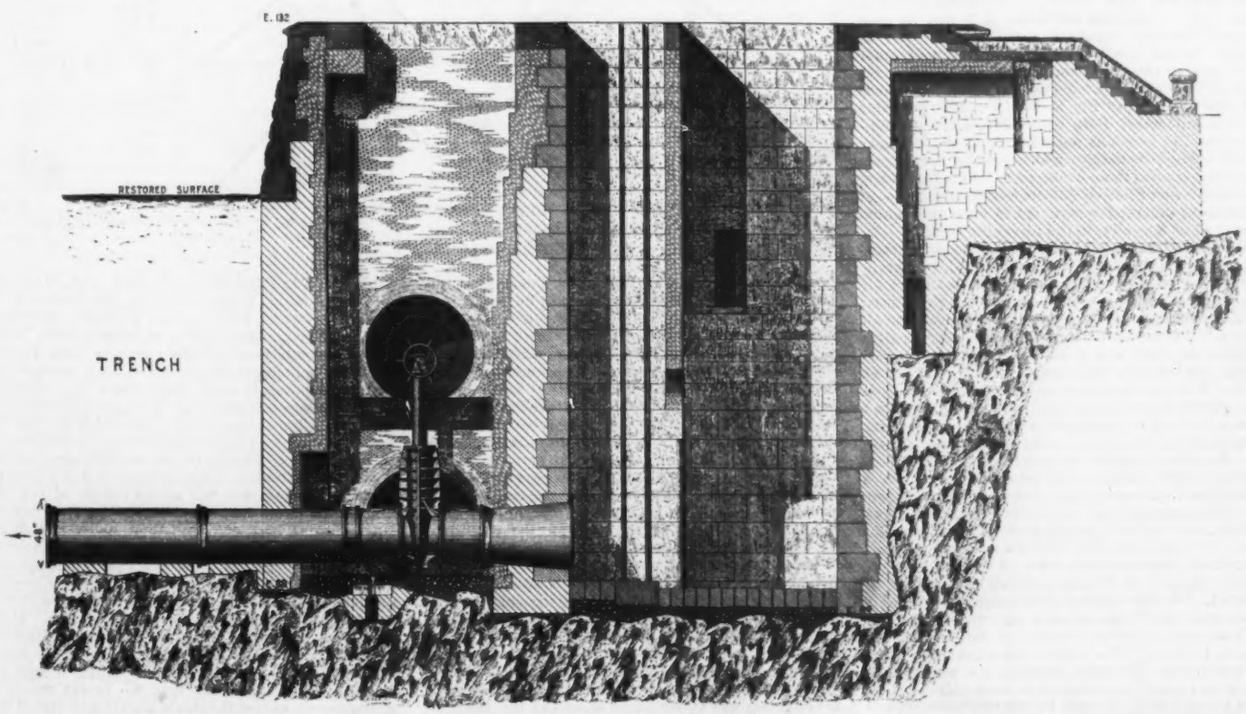


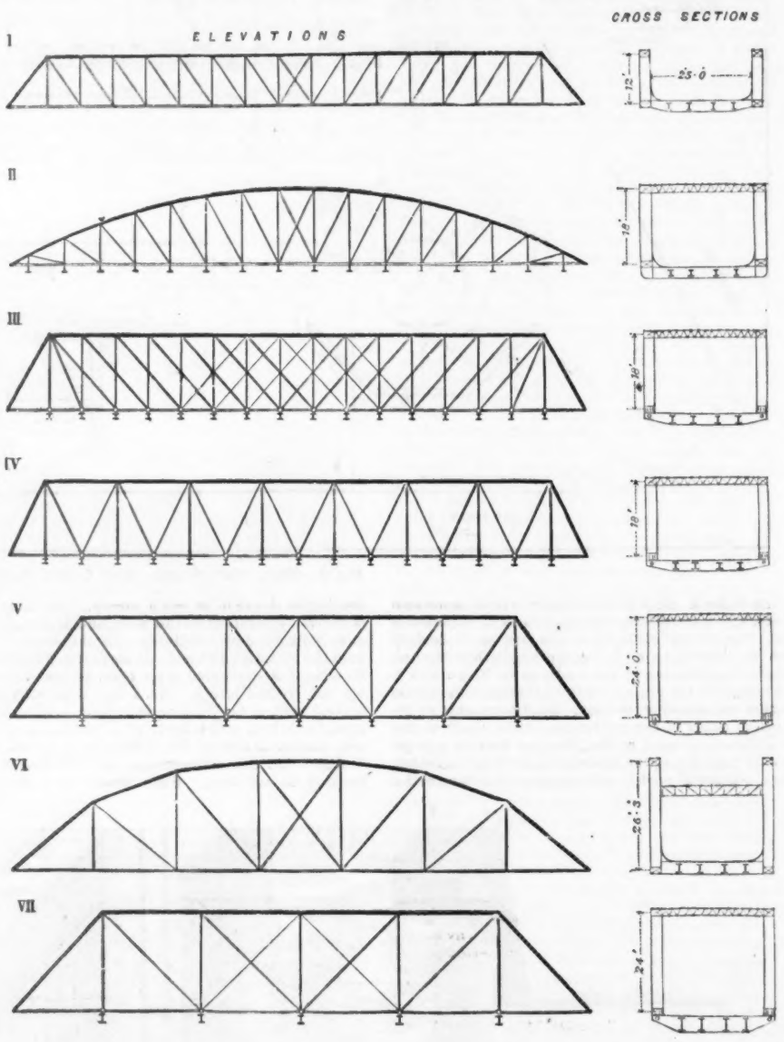
Fig. 3.—Sectional View; Gate House. New Croton Aqueduct.

girder decreases as the depth increases is generally applicable to an extent which, if recognized in theory by English engineers, has not hitherto found general expression in their practice. The extra depth required for the rail bearers in bridges with long panels is, however, in England, where the headway is frequently very limited, more often than elsewhere prohibitory of the adoption of the most economical form for the main girders; and although the question of design requires careful study, there is no evidence of the existence of inherent national error or prejudices in design which would be likely to place English engineers at a disadvantage in dealing with Colonial work, or to account for the fact that they had lost it in Canada and recently in one case in Australia. It has been suggested that the position of the designer in America is more favorable to economy of construction. In America when a bridge is required the railroad company invites tenders for its construction and erection in accordance with their specification, which generally states the class of bridge preferred, the load which is to carry, and the quality of the material, and defines in considerable detail the stress to which its parts may be subjected. The design is left to the bridge company tendering for its construction, but it is required that sufficient information shall be supplied with each tender to enable the railroad engineer to examine the proposal and determine whether it fulfils the required conditions. The designer, who is consequently employed by the bridge company, has in the first place to produce the most economical structure, while the primary responsibility for its safety lies with the railroad engineer, who has prepared the specification and will be enabled to check the correspondence of the design with his requirements before the tender is accepted, and to make the necessary modifications—a work of considerable difficulty unless the design is a good one to begin with. The English designer, on the other hand, has in the first place to design a safe structure, since he is seldom immediately subject to competition in respect to its economy, and is entirely responsible for its security. In the interest of security the advantages of the English system can hardly be disputed. Its economic advantages are that the engineer is seldom able to ascertain either the exact cost of his designs or the relative economy of their details; nor has he any personal interest to serve or any other inducement to reduce the cost to the lowest point. The system, moreover, entails a want of correspondence between the design and the appliances of the manufactory, where it is afterwards executed, especially if the work is let by open tender. These disadvantages are accidental rather than essential in their nature, and this should rather suggest their remedy in detail than the condemnation of the system under which they arise. Much could be effected by manufacturers to promote economy in design by the publication of particulars of the relative cost of different details of construction, in such a way as not to injure their commercial interests. It is also an open question whether standard sections could not be adopted for the usual sizes of angle, tee, and other rolled bars, so that no difficulty need arise—in this respect at least—in making the design in accordance with the scantling of the materials readily available for its manufacture. Both the design of bridges generally and the personal position which the designer should occupy, are matters which may be left entirely to the discretion of those concerned; but engineers are, in England, very properly subject to a certain degree of Government supervision in regard to structures which directly affect the safety of the travelling public.

The Board of Trade have exercised since 1840 a statutory power of inspecting and testing bridge on railways for passenger traffic, and have issued rules for the guidance of engineers in designing the structures; which have been generally accepted as applicable to all bridges, and exercise a strong influence over English engineers in their use of iron and steel in all permanent engineering structures, either at home or abroad. It is provided by these rules that the greatest strain produced by the combined moving and dead load on any part of a structure, shall not exceed for wrought-iron 5 tons, and for steel 6¾ tons per square inch. No defined quality or strength is required in order that either material may be subjected to these stresses, but in the case of steel the engineer must certify that it is possessed of considerable toughness and ductility, and state the tests to which it has been subjected. It is also provided that the heaviest engines, boiler trucks, and travelling crane in use on railways shall be a measure of the load to which bridges may be subjected. For convenience, the strength of bridges is usually measured by an assumed uniform load per foot run intended to cover the weights of the heaviest engines and trucks. The proper equivalent has often been a matter of dissension, which is not remarkable, as it varies for any given engine or combination of engines, not only with the span but also with the mode of using the equivalent itself.

This may be seen by the diagram† representing the equivalent uniform load producing at any point in a beam a moment of flexure equal to or greater than that produced by a given system of loads, as is required for designing beams of which the section is varied in the usual way for all but the smallest plate girders. The diagram shows how important the rolling load becomes in small girder bridges and in the floors of large bridges, matters which have certainly not been properly considered in numerous existing examples in England. It will be seen that the equivalent load for each system varies in a somewhat erratic manner with the span; sometimes one and sometimes another determines the maximum. Hence the determination of the greatest load to which a bridge may be subjected in the manner directed by the rules leaves a considerable opening for error, and affords an excellent example of the insufficiency of any rule, however perfect, to relieve the engineer of a large amount of responsibility. The origin of the rules may be traced in the parliamentary reports of the Board of Trade and of the Railway Commissioners, who, from 1846 to 1851, exercised the powers of the Board of Trade with respect to railways. From these reports, it does not appear that previous to 1849 the inspecting officers had a defined rule for the strength of bridges, either of wrought or cast-iron. In 1847, however, a Royal Commission was appointed in the following terms: "To inquire into the conditions to be observed by engineers in the application of iron to structures subject to violent concussions and vibrations," and "to endeavor to ascertain such principles and to form such rules as may enable the engineer and mechanic to apply the metal with confidence, and to illustrate by theory and experiment the action which takes place under varying circumstances in iron railway bridges which have been constructed." The terms of this Commission clearly indicate that the interest of the engineer was to be studied as well as the safety of the public. The Commissioners were Lord Wrottesley, then president of the Royal Society; the Rev. Robert Willis, M. A., an eminent mathematician; Captain Henry James, of the Portsmouth Dockyard, and three civil engineers, Messrs. George Rennie, William Cubitt, and Eaton Hodgkinson. After examining the leading engineers and ironfounders of the day as to their experience and practice, and making numerous and elaborate experiments, the Commissioners reported that "legislative enactments which would fetter scientific men in the development of a subject as yet so novel and rapidly progressive would be highly inexpedient."

They, however, made certain recommendations with respect to cast-iron bridges, which are substantially the same as the present rule for cast-iron structures: That the breaking weight should be six times the moving load, added to three times the dead load. They also made a further recommendation, applicable to all elastic horizontal bridges, that provision should be made for the increase of strain in bridges under 40 feet long, when subject to a rapidly moving load, as indicated by the increased deflection in such cases—a recommendation which until recent years was lost sight of. These recommendations were, immediately upon the publication of their report, embodied by the railway commissioners in a circular letter of instructions to their inspecting officers. On the day following the date of this letter, Captain Simmons inspected the Torksey Bridge, a wrought-iron box girder bridge, of two continuous spans of 130 feet, designed by Mr.—now Sir John—Fowler, and objected to it as of insufficient strength. Its rejection was discussed by the Institution of Civil Engineers, and the Railway Commissioners were accused of applying to wrought-iron the recently published recommendation of the Commission on Iron requiring a factor of six for cast-iron bridges. At the same time, a lengthy correspondence took place between Mr. Fowler and the Commissioners, and Captain Simmons decided—after the examination of such examples as were available—that the bridge should be strengthened, so that the strain should not exceed five tons per square inch. In fixing this he admitted that there was no decided authority upon the subject, and that the variation in the circumstances of the construction of bridges prevented the application of an invari-



† As this diagram is in many colors, it is impossible to reproduce it here.—Ed.]

able law. He recognized as a principle the variation of the admissible strain in a bridge according to the proportion of live to dead load, a point which has been recently rivived. In the end—after a special examination to test the continuity of the spans—the bridge was accepted with a strain, under the most favorable estimate, of slightly over six tons per square inch.

Between 1850 and 1858 the rule for cast-iron bridges appears to have found general acceptance, while there is conclusive evidence of the absence of a defined limit for the strain in wrought-iron structures. In 1858 a wrought-iron tubular girder bridge over the Spey was brought before Captain—now Sir Henry—Tyler some time before its completion, and a lengthy correspondence ensued between Captain Tyler and Mr. Fairbairn with reference to its strength. This correspondence Captain Tyler laid before the Board of Trade, who on 30th of March, 1859, issued a circular letter of instructions, fixing 5 tons per square inch as the proper limit of strain for wrought-iron. Upon this Captain Tyler based his rejection of the bridge on the 30th April. It is very important to note that this rule was explained at the time by Captain Tyler to represent a factor of safety of four for combined moving and dead load. It has not since been altered, and in practice it is assumed to be applicable to all wrought-iron, whether the quality be good or not. Among the numerous considerations suggested by the survey—after the lapse of over twenty-five years—of the period of which a brief sketch has been given, the most striking is the confirmation which experience has given to the conclusions of the Commission of 1847. Derived from the interpretation by skilled mathematicians of the results of experiments conducted by practical engineers, combined with the evidence of the ablest engineers of the time, their conclusions were based upon a solid foundation of fact and experience. Their recommendations, although jealously resented by civil engineers at first, notwithstanding the avoidance of legislative interference by which freedom was secured for the development of engineering science led, under the judicious interpretation of the inspecting officers, to the present rule for cast-iron structures. This rule is good in principle because it derives the load—and consequently the stress—to which the structure may be subjected, from the actual strength of the material. The present rule for wrought-iron has no such foundation, and it is indeed only due to the high professional attainments of the inspecting officers, and the sound judgment and great moderation with which they dealt with the difficulties which naturally arose when wrought-iron first became generally used, that the present rule, introduced without special experimental research, has endured so long that it has obtained the sanction of what to younger engineers at least is an immemorial usuage, taken for granted and stereotyped beyond reach of improvement. Its principal fault is in allowing a fixed limit of stress without regard to the quality of the material. This does not lead to serious results so long as the limit of 5 tons per square inch is understood to represent a factor of safety of four applied to iron having a breaking strength of not less than twenty tons, as explained by Captain Tyler in 1859; but it must not be forgotten that the rule itself is used by many who do not know its origin, and the absence of any stipulation as to the strength of the material leads naturally to the assumption that five tons represents the safe working stress for any quality of iron in the market and many inexperienced engineers do so interpret and use it. It is hardly necessary to state that there are many qualities of iron for which such an assumption would be attended with considerable danger, but it is not so apparent that a bridge made of utterly untrustworthy material might not, under the ordinary tests, afford any indication of its insecurity. Such is, however, the case, and the safety of the public depends in this respect very much more upon the choice of a suitable material by the engineer than upon the Board of Trade rule. A fixed limit of stress without regard to the quality of the material also restricts the engineer in the development of economic design in the direction of a greater use of better material, such as angle and bar iron of superior strength and ductility. Nor does a fixed stress offer any inducement to the manufacturer to improve the quality of plates. These considerations apply with much greater force to the present rule for steel. As a material, steel is much more variable in its strength than iron, which renders the application of an invariable coefficient more objectionable. It is true that the Board of Trade, in accordance with a recommendation of the Committee of 1877, appointed at the instance of the British Association, allow in special cases the use of steel with a higher stress, but exceptions of this nature are naturally ill-adapted to the design of bridges of ordinary spans. The rules cannot be regarded as suited to the nature of the material, and there can be little doubt that they have operated to hinder the application of steel to uses for which it is admirably suited, and have thus exercised a prejudicial effect upon one of the leading industries of the present day. Unless the rules which determine limiting stresses or coefficients for iron and steel can be brought into conformity with modern knowledge of the properties of materials, and of the laws by which their application to construction should be regulated, their entire abolition would be preferable, because it would conduce to the advancement of engineering science, and the development of the bridge-building industries. The safety of the public need in no respect be compromised by the abolition of the limiting stresses, if the rules requiring the engineer to certify the quality of the material used were retained—and extended to apply to iron as well as steel—in order to provide the inspecting officer with all the information requisite to enable him to judge whether the stress to which a structure was subjected was within safe limits. Freed from the deadly influence of the fixed coefficients, private enterprise would establish standard rules for the determination of the stress to which different materials under varying conditions might safely be subjected, to the great advantage of the professions and trades interested in bridge-building, and having in future to compete with the Americans. On the other hand, there are many objections to such a course, which would practically amount to a reversion, after the experience of thirty years, to the condition of 1850. It is also to be feared that, during the time which must necessarily elapse before any rules obtained the sanction of a common assent, differences of opinion, causing much inconvenience, would probably arise between civil engineers and the inspecting officers of the Board of Trade—which is much to be deprecated. A course more worthy of the scientific attainments of English engineers would be the amendment of the rules, so that, while leaving to the engineer the greatest possible freedom in the choice of design and material, and leaving in his hands the responsibility for the correct determination of every effect of the loading of a structure which the most modern methods render calculible, they should determine for his guidance, by coefficients based upon experience, or, where practicable, upon experimental research, the proper allowance to be made severally for each of all those effects which are usually understood to be covered by the present arbitrary factor of safety. Rules so designed could not fail to exercise an elevating effect on the professional knowledge and skill of engineers by affording a more distinct conception of the effects for which the factors of safety provide, and by abolishing the use of coefficients of which neither the origin, scope, or intent are known to the user. The division of the factor of safety into many separate coefficients, some of which would vary with the quality of the material and character of the workmanship, would encourage good workmanship and the use of materials of a high class without restricting the use of materials of a lower class and less perfect workmanship for purposes to which they are adapted, and would thus be in the highest degree beneficial to the manufactures' interest. These results can hardly be attained otherwise than by rules framed upon the recommendations of a Royal Commission who could bring to their aid the experience of the inspecting officers and of the leading engineers and manufacturers, and institute special experimental research to elucidate any doubtful questions. Such a Commission would indeed be but a revival of that of 1847 to complete the work which the former Commissioners were compelled to abandon in 1849 because the application of wrought-iron to engineering structures was yet in its infancy, and steel in its modern form unknown; and the scope of their inquiry could hardly be better defined than in the terms of the former Commission. The draft rules appended have been prepared to show that the views above expressed are capable of taking a practicable form, and to render more easily apparent the advantages claimed for them.

APPENDIX.

Abstract of Suggested Rules for the Control by the Board of Trade of the Design of Structures of Wrought-Iron and Steel.

Note.—The formulæ and numerical values inserted in italics are intended merely as suggestions of theories requiring further investigation for their establishment or as estimates of the values which experimental research or experience would assign to the various coefficients.

Rule 1.—Structures of wrought-iron or steel to be so proportioned that the calculated stress in any part due to the weight of the structure, together with the moving load set at rest upon the structure, shall not exceed that specified under Schedule D. Stresses due to wind alone not to exceed *1.5* times, and stresses due to the combined effect of wind and load *1.25* times, the specified stresses.

Rule 2.—Provision to be made for moving loads upon main girders, platforms, and bracing, according to Schedules A, B, and C.

Rule 3.—All structures to be designed to resist lateral forces, including not less than *30* pounds per square foot for wind pressure. In lofty or exposed situations greater allowance to be made for wind.

Rule. 4.—Engineer to certify both for iron and steel that the material used is, in his opinion, suitable for the purpose to which it is applied, and to supply a statement of all the tests to which it has been subjected, including in all cases those required for the determination of the working stress under Schedule D.

Schedule A.

Equivalent uniformly distributed load for designing girders of which the cross section is varied; based upon the formula

$$w = 1{,}90 + \frac{25}{S},$$

in which S = span in feet, and w = load in tons per lineal foot for one track estimated to produce at any point in a beam a moment of flexure equal to or greater than that produced by any arrangement of the heaviest engines and boiler trucks.

Span	8	10	15	20	30	40	50	60	80	100	Feet.
Load	*4.72*	*4.40*	*3.27*	*2.85*	*2.43*	*2.25*	*2.10*	*2.02*	*1.91*	*1.85*	Tons per ft. run.

Schedule B.

Equivalent uniformly distributed load for designing bridges of uniform section and depth, based upon the formula:

For spans under 12 feet..... $w = \frac{36}{S}$

For spans of 12 feet and upwards $w = 1{,}9 + \frac{25}{S+5}$,

in which w = load in tons per lineal foot for one track estimated to produce a maximum moment of flexure equal to or greater than that produced by any arrangement of the heaviest engines and boiler trucks.

Span	8	10	15	20	25	30	40	50	60	Feet.
Load	*4.50*	*3.60*	*2.85*	*2.60*	*2.43*	*2.31*	*2.16*	*2.05*	*1.99*	Tons per ft. run.

Schedule C.

Table of the greatest "panel" or cross girder loads derived from the formula:

For panels over 6 feet in length $W = 1{,}90\ P + \frac{25}{2 + \frac{5}{P}}$,

in which W = panel load in tons for one track, and P = length of panel in feet.

Length of panel (P)	0 to 5	6	8	10	12	20	25	Feet
Load (W)	*18.0*	*18.4*	*22.3*	*26.0*	*29.6*	*43.1*	*51.4*	Tons

The above represents the maximum load on a single panel, but the greatest mean load on N consecutive panels might be taken as

$$W = 1{,}90\ P + \frac{25}{N + 1 + \frac{5}{P}}.$$

Schedule D.

Admissible stress in wrought-iron and steel under varying circumstances.

I.

In cases where the material is subject to stress of one character only.

(a) Limited working stress under any conditions.

$$a = \frac{t}{NC},$$

in which a, is the greatest stress to which the material may be subject under any conditions of loading;

t, the ultimate tensile strength of the material determined by experiment;

C, product of all the tabular coefficients of safety (p. 4 *post*) applicable to the particular case;

N, a coefficient intended to ensure that the greatest actual stress, in the extreme case of the coincidence of all the conditions detrimental to the resistance of the material, represented by the tabular coefficients, shall not reach the limit of elasticity.

	N.
For wrought-iron	*2,25*
For steel, tensile strength under 30 tons per sq. in.	*2,00*
" " " 32 "	*2,04*
" " " 35 "	*2,11*
" " " 40 "	*2,23*
" " " 45 "	*2,36*
" " " 50 "	*2,50*

As it is of the utmost importance that steel should be uniform in strength, if the greatest tensile strength

when tested exceed the least by more than 15 per cent. the limiting stress shall be reduced.

Percentage of variation in tensile strength ...	16	20	30	40	50 or more
Percentage by which the limiting working strength should be reduced (arbitrary)..	1¼	7½	22½	37½	50

(*b*) Ductility required in order that any material may safely be subjected to the limited working stress (a) *to vary with the proportion in which the stress is caused by a varying or live load; and may be determined from*

$$\delta = 50\,(1 - \Phi),$$

in which δ *is percentage of contraction of area of fracture under tensile stress, and* Φ *(as in the Launhardt-Weyrauch formula) denotes ratio of constant to total load.*

$\Phi =$	1,00	0,80	0,60	0,50	0,40	0,30	0,20	0,10	0,00
$1 - \Phi =$	0,00	0,20	0,40	0,50	0,60	0,70	0,80	0,90	1,00
$\delta =$	0	10	20	25	30	35	40	45	50

Materials which do not exhibit the ductility required by the conditions under which they are strained are only to be subjected to a stress $b = a\,k$, *in which* b *is the admissible stress in a material of which the actual contraction of area is* Δ, *used under conditions of loading for which the required ductility is* δ, *and* k *is a coefficient derived from the empirical formula*

$$\frac{2}{k^k} = \frac{\Delta}{\delta}.$$

Table of Values of k.

Ratio of actual to required ductility. $\frac{\Delta}{\delta}$	*Ratio of admissible to limiting stress.* k	$\frac{\Delta}{\delta}$	k	$\frac{\Delta}{\delta}$	k
		0.70	0.859	0.35	0.694
1.00	1.000	0.65	0.836	0.30	0.667
0.95	0.976	0.60	0.813	0.25	0.640
0.90	0.950	0.55	0.790	0.20	0.612
0.85	0.928	0.50	0.766	0.15	0.578
0.80	0.905	0.45	0.743	0.10	0.537
0.75	0.882	0.40	0.719	0.05	0.483
				0.00	0.000

II.

In cases where the material is subject to tension and compression alternately.

The admissible stress to be less than when subject to tension or compression alone, *and may be determined from the formula.*

$$b^1 = b_0 \left(1 - \tfrac{1}{4} \frac{Max\ B^1}{Max\ B}\right),$$

in which b^1 *is the admissible stress in a bar subject to alternate stresses of which* $Max\ B^1$ *is the numerically lesser and* $Max\ B$ *the numerically greater, and* b_0 *the admissible stress in the material for* $\Phi = 0$. *This expression is derived from that of Dr. Weyrauch by substituting for the coefficient, derived from the primitive strength of the material by an arbitrary factor of safety, the value of* b_0 *determined by the preceding formula with respect to the ductility of the material.*

TABLE OF COEFFICIENTS OF SAFETY.

I. For vibration shock and other dynamic effects. *For wrought-iron or steel, minimum 1,33 for structures over 25 feet span, for 20 feet span 1,42, for 15 feet span 1,60, for 10 feet span 1,75.*

II. For unequal distribution of stress and secondary stresses. *Minimum for wrought-iron 1,20, for steel 1,40. Additional for bracings generally: In pin-jointed structures 1,05, in rivetted structures where the breadth of bars is less than 1-12th length of bay or depth of girder, depth of girder is greater than 1-8th span, and bars are not joined at crossings 1,10. In rivetted structures otherwise 1,15. Additional for steel plate girders 1,10.*

III. For ambiguity of stress or failure of continuity. *Minimum 1,00. For ambiguous systems of bracing 1,33, for continuous girders generally 1,16.*

IV. For errors in design and workmanship. *Minimum 1,03. Additional for punched holes: In iron plate girders 1,05, in iron framed structures 1,15, in steel plate girders 1,15, in steel framed structures 1,30.*

V. For irregularities in section and rusting generally *1,03.*

(Product of minima coefficients for iron *1,70*; for steel *1,98.*)

The specified coefficients of safety are not intended to include provision for increase of stress due to an obvious want of symmetry in the attachments or section of members, bending stress due to their weight, or liability of struts to buckling; these and other calculable additions to be made to the stresses estimated from external loading.

In the case of solid beams or plate girders the admissible stress to represent the extreme fibre stress, accepting the ordinary theory of bending.

Experimental determination of resistance to flexure is recommended in the case of solid beams of unusual section.

For solid round pins the extreme fibre stress may exceed the specified stress by *33 per cent.* in iron and soft steel, and *20 per cent.* in hard steel.

Shearing stress in general to be taken as *4-5ths* the admissible tensile stress in the same material, but when of different materials the shearing strength of rivets and pins to be based upon the strength of the materials of which they are made.

Coefficients applicable to members joined to be applied to joints.

Pressure on bearing area not to exceed *1,5* times the admissible tensile strength of the weaker material, whether of rivet, or pin, or that in which the hole occurs.—*Engineering.*

ACCIDENTS IN MINES.*

(*Continued from page 262.*)

VI.

Removal or Treatment of Dust Accumulations.

From information which Your Commissioners have collected they find that the removal of accumulating dust is practiced to some extent here and there; but this measure is obviously attended by many difficulties, and even if carried out as thoroughly as practicable, it would generally only be the main roads that could be kept fairly free from dust, in many mines. The removal of dust from the vicinity of the particular places where blasting is carried on must always be an imperfect operation, involving serious additional labor. At the best it can only be to some extent palliative measure, in localities where small proportions of fire-damp exist in the air, or where the coal dust itself is exceedingly inflammable and dry, because the still remaining dust will, when raised by a blown-out shot, in all probability suffice to add to, and carry on considerably, the flame developed and the disturbance produced, and may cause comparatively distant dust-accumulations to be raised and become inflamed.

If, however, the maintenance of the mine-ways, generally, as free from dust as practicable, and the removal of the principal part of dust-accumulations from the working places, can be supplemented by the application of some efficient method of rendering the remaining dust innocuous in the presence of a blown-out shot, there can be no doubt that the dangers arising from coal dust will be very greatly reduced, if not rendered altogether insignificant.

The most obvious expedient for depriving dust of its dangerous character is to maintain it in a sufficiently moist condition, in the immediate vicinity of the working faces, to prevent its becoming suspended in the air to any important extent by the action of the rush of gas emanating from a blown-out shot. In the event of the occurrence of fire-damp explosions, the augumentation of their extent and of their destructiveness to life, by the raising and ignition of dust in parts of the mine more or less distant from the seat of the first explosion, may probably be to a considerable extent guarded against by maintaining the floors of the workings and mine-ways sufficiently moist to effectually lay such dust accumulations as have not been removed. From inquiries which we have instituted it would appear that the watering of roadways have become a somewhat general practice in some districts, while on the other hand the practice of watering in the immediate vicinity of the working places or of watering the working places themselves or the face of the coal, shortly before shot-firing, appears to be a very exceptional one. In several important instances watering of any kind was reported to them as being considered either impracticable or useless. The prejudicial effect of watering upon the floor or bottom, in the headings and stall roads, and the increase of its tendency to heave or "puck" if maintained in a damp or wet condition, are advanced by some as very serious objections to the employment of water, either at all, or at any rate to a sufficient extent to render it really effective in preventing the dust from flying. The results of some trials quite recently made by the Prussian Commission in the experimental gallery at Neunkirchen appear to have demonstrated that a readily inflammable coal dust was rendered harmless only by being moistened with above two-thirds of its weight of water; when the dust was in that condition the liquid could be pressed out of it by the clenched hand. If the dust was made thus wet, it was found that the watering need not extend farther than the distance to which flame from a blown-out shot would reach, but as this might amount to a distance of 50 or 60 feet with a very highly inflammable coal, and especially if the air continued some small proportion of fire-damp, the experimenters appear to have been led to the conclusion that thoroughly effective watering is scarcely practicable under some circumstances.

The generally elevated temperature of mines combines with the desiccating effect of the more or less rapidly circulating air-currents to counteract the amount of protection attainable even by frequent liberal watering. Hence attempts have been made within the last six or seven years to promote the retention of water by coal dust, by the application to it of hygroscopic or normally deliquescent bodies. Crude salt was tried in the first instance, and in 1879 Professor Stokes suggested the watering of the dust with a solution of calcium chloride, a highly hygroscopic salt which had been successfully applied in connection with street watering, and is procurable in abundance as a cheap bye product of some chemical works. But its trial in some dry deep mines in South Wales and also in the Jabin pits in France was not attended with success; the highly deliquescent salt actually crystallized out, consequent upon the rapid evaporation of the water in the warm air-currents. Some amount of success appears however to have attended the application, in mines in North Staffordshire, of crude or refuse salt; this contains a very notable proportion of the magnesium cloride, which is, if anything, more hygroscopic in its character than the calcium salt. In an interesting discussion which followed Mr. Robert Stevenson's communication of his favorable experience in this direction to the North of England Institute of Mining Engineers, the view received some support that the deliquescent salts would be most operative if used in admixture with sodium chloride, as is the case in crude or rock salt. The proportion of crude salt which Mr. Stevenson had found effective in maintaining the dust sufficiently moist to prevent its flying, was nine tons per 500 yards of 6 feet roadway, applied once weekly, for the first month, and once a month afterwards. Even if the application of hygroscopic salts in this direction proves to be of little avail in very deep and dry mines, it may at any rate prove decidedly beneficial in many localities, and the favorable experience acquired in the North Staffordshire collieries therefore merits the serious attention of owners of mines in which similar conditions prevail.

The observation recently made in Germany, in some preliminary experiments, that a thin layer of fine angular sand strewn over mine-dust appeared to have the effect of preventing

*From "Final Report of Her Majesty's Commissioners appointed to inquire into Accidents in Mines, etc," 1886.

the communication of flame from a blown-out shot to all but the most highly inflammable dusts, is worthy of a passing notice.

Attempts to Prevent the Occurrence of Blown-out Shots.

Various devices have been tried from time to time to prevent the blowing out of shots, but little or no success. In illustration of these may be quoted the use of special tamping materials, suggested as likely to oppose greater resistance to the gases developed by the explosion, and the insertion into the holes, over a short tamping, of a tightly fitting iron-rod or bar, terminating at the outer end in a sphere of iron of great weight which was expected to offer sufficient resistance to prevent the projection of the tamping and the consequent issue of flame, but which did not fulfil this expectation. The most recent device of this class and one which appeared at first sight to present greater prospect of efficiency than any yet tried is so-called *blasting plug* patented by Mr. Stephen Humble. This consists of a perforated rod or spindle of a length corresponding to about the length of this particular kind of tamping required, and having a screw-thread at each end; upon one end is screwed a conical brass nut, a long cylinder of somewhat rigid vulcanized india-rubber is slipped over the rod; and a nut with a broad base is screwed over it on the extremity of the rod; by the pressure of this nut upon the end of the india-rubber tube the latter is compressed longitudinally and thus made to expand laterally. If, consequently, this arrangement is placed over the charge of explosive in a hole into which it can be inserted without difficulty, and the screw nut is then tightened, the india-rubber can be made to press very tightly against the walls of the hole, and it is claimed that the charge is thereby much more strongly confined than by the hardest ordinary tamping, the hole being most securely and expeditiously stopped. The fuze required to fire the charge is passed through the perforation in the spindle. For long holes, or in order to attain more uniform and complete expansion of the india-rubber tamping, the latter is sometimes built up of several short cylinders, between the ends of which nuts in the shape of double cones are slipped upon the rod; when the top nut is tightened, these aid in compressing the india-rubber at the several parts of the tamping where they have been inserted. The comparatively very considerable cost of these plugs would probably constitute a grave hindrance to their extensive employment even if found very effective, but it is contended that they are seldom at all injured by the firing of the shot, o that they may be used a very great number of times.

One of Your Commissioners has had several trials made of these blasting plugs in Pwllypant Quarry, near Caerphilly. In the first experiments, a very strong hole 3 feet deep by 2 inches in diameter, in solid hard rock, was used. It was charged with 1 pound of powder the tamping plug was then pushed down upon the charge, and the screw-nut was tightened, first by hand, pipe-tongs being afterwards used to screw it down as far as possible; the fuse was first inserted through the centre of the rod carrying the plug. The result of firing was a blown out shot, the shot hole remaining quite uninjured. After a long search some small fragments of india rubber were found in the direction of the hole and at a distance of about 150 yards from it. The hole was recharged with 1 pound of powder, tamped as before, but with a double coned plug, a single coned plug having been used with the first charge. A blown-out shot again occurred; the metallic parts of the plug passed through a wooden sleeper and an ¾-inch wrought-iron plate, which were in front of the shot-hole, and some fragments of india rubber were recovered, projected to a considerable distance. A hole 3 feet deep by 2 inches in diameter, in a less strong place, was loaded with the customary powder-charge for the work to be performed (2¼ pound), and the tamping plug was applied as before; the work was well done, but no vestige of the plug could be found. A fourth experiment, of the same nature as the last, furnished a like result, except that one of the india-rubber cylinders, of the double coned) plug was found, in a damaged state, at a distance over 150 yards from the shot-hole. Some trials of these tamping plugs, carried out by the Royal Engineer Committee as Chatham, furnished results similar to the foregoing. A 2 ounce charge of dynamite was placed into a shot-hole, and the tamping plug was applied, but it subsequently appeared that the nut had not been screwed down sufficiently to expand the plug-washers properly; the shot simply projected the plug to a considerable distance, and it was recovered uninjured. Two shots, in holes 11 feet 6 inches deep and 1¼ inch diameter, were charged each with 2 ounces of powder, and the tamping plugs were carefully applied. The charge produced good results, but the plug was blown to pieces in each instance.

The foregoing results show that this form of tamping plug, if applied with care, may perform the functions of common tamping; but there were no indications of its offering greater resistance than good tamping of the ordinary description, and of consequently deducing a tendency of the occurrence of a blown-out shot. As the plugs appear to be destroyed whenever they are effectively applied as tamping, and, as they are very costly, they can only be regarded as a highly extravagant substitute for the usual tamping, presenting no advantage beyond being perhaps somewhat more expeditiously applied.

VII.

Explosive Agents, and Particular Methods of Using Them.

The flame which generally, though to a very variable extent, attends the explosion of a charge of blasting powder confined in a shot-hole, and more especially the very considerable volume of flame developed, and the distance of its projection, either when a shot-hole is over-charged, or when insufficient tamping or great strength of the material operated upon gives rise to what is termed a "blown-out shot," are sources of danger, attending the use of powder in coal mines, which were recognized long before the question of a possible connection of coal dust with disasters consequent upon shot-firing was first raised.

In the evidence taken by us, considerable diversity of opinion was however expressed as to the extent of danger attending the employment of gunpowder in coal mines and as to the advisability or possibility of abolishing its use; some few men of great practical experience were strong advocates of the discontinuance of shot-firing, while the majority of those who have knowledge and practical experience of the conditions and circumstances obtaining in districts where powder has hitherto been largely used, held that to abolish shot-firing in the working of coal would be attended with difficulties of the gravest character, and must indeed lead to the closing of many pits.

Even the enforcement of restrictions, in connection with shot-firing in mines, much in excess of those contemplated by the eighth General Rule of the Mines Regulation Act would, in the opinion of many colliery owners and managers, tend to affect the trade very disastrously, and hence the order or rule proposed to be introduced last year by the late Secretary of State for the Home Department, directing that no shots are to be fired in a colliery within a period of three months after the existence of gas has been there reported, during the time that the workmen are engaged in the mine, has called forth widespread antagonism.

In May, 1884, we were requested by Your Majesty's Secretary of State for the Home Department to express an opinion upon a resolution which had been submitted to your Inspectors of mines by one of their body at their annual meeting, and which was supported by only a very small minority of those Officials, to the effect that in the opinion of the Inspectors of Mines, the use of "powder or other explosives should not be allowed in any mine subject to fire-damp, unless the whole of the work-persons are out of the mines, except those actually employed in the blasting operations." This resolution was met by the proposal of the following amendment, which received the assent of a large majority of the Mine Inspectors present: "that the present eighth general rule, if stringently carried out, appears to be sufficient without any alteration of the Act." Your Commissioners having carefully considered the matter of reference, reported that they concurred with the majority of the inspectors present at meeting referred to, in the course they took in declining to adopt the restrictive resolution. The proposal of that resolution appears, however, to have had the effect desired by those who espoused it, inasmuch as the circular issued some months afterwards by the Home Secretary was substantially in accord therewith.

Your Commissioners, having already in the earlier period of their deliberations given the subject of shot-firing in mines their most anxious attention, were convinced, by the evidence brought before them, as well as by the practical experience of some of their colleagues, and by the results of their personal inspection of coal-mine working, that if shot-firing were abolished, or indeed even if the existing restrictions, which the Act prescribes in connection with shot-firing, were very greatly increased in stringency or extent, a large number of pits exist which it would be either impracticable to work at all with the resources at present known, or which it would be impossible to work except at such pecuniary outlay as might prove prohibitory. On the other hand, your Commissioners were deeply impressed at the outset with the dangers attending the employment of gun-powder or blasting powder in coal-mine workings, and with the extreme difficulty of averting or of considerably diminishing those dangers when carrying on their use in getting coal, working stone drifts, etc., in the ordinary manner, with due attention to the prescribed precautions. They have, therefore, carefully examined into the merits of different powder surrogates, and of different methods of applying powder and other explosives, with special reference to the possibility of avoiding the development of flame in the possible presence of an explosive mixture of fire-damp and air, or in the air of the mine in which, at the time of firing a shot or by the explosion of the shot itself, coal-dust or mine-dust is, or becomes thickly suspended, there being possibly also some proportion of fire-damp present.

TO BE CONTINUED.

The Roadmasters' Association.—At the recent annual meeting the following officers were elected: President, John W. Craig, Charleston, S. C.; First Vice-President, C. E. Jones, Beardstown, Ill., Second Vice President, C. W. Preston, Des Moines, Ia.; Treasurer, Thomas Adamson, Aurora, Ill.; Secretary, D. P. Lovell, Ravenna, Pa.

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MAGAZINE RENEWALS.

The *Century Magazine* closes its yearly volume with the *October Number*. Renewals are in order for November. The price to ENGINEERING NEWS subscribers and their friends is $3.55; with ENGINEERING NEWS, $3.55. The new *Scribner's Magazine* will be out December 1, and we will make liberal terms to subscribers. *Harper's Monthly* is renewable on December 1 Orders ought to be sent in in November to save the publishers trouble.

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THE board of experts appointed to examine into the Fifth Avenue paving job in this city, consisted of Julius W. Adams, Wm. E. Worthen and Robert Van Buren, all well-known and experienced civil engineers. These gentlemen report, in effect, that the pavement was built in accordance with the terms of the contract under which the work was done; and that under the wording of the contract and specifications the resulting pavement was "good, firm and substantial." The report does not go into detail, as these gentlemen were practically limited to the above expression of opinion by the wording of their appointment.

While this decision will be gratifying to the contractor, a disappointment to some men, and is evidently a puzzle to the daily press, for they say very little about it, it is only a natural result. Three fair and experienced experts have pronounced judgment, with a contract and specification framed by the contractor as their only legal guide; and they could do little else than decide as they did.

As pointed out by us some weeks ago, the first wrong committed against the city's interest was in the very act of May 28, 1885, authorizing the paving of Fifth Avenue. That document ordered that plans, proposals *and specifications* should be submitted unopened to the board which was to select the one likely to secure the "best description of such pavement;" but this board also had the usual right to reject any or all such proffers. Commissioner Squire and the remainder of the board accepted the specifications of Mr. Matthew Baird on October 28, 1885, with the result now well known to the public; and under these specifications the experts have just based their decision, in so much as they are binding upon the city.

IN connection with the New York event of this week, that is the unveiling and dedication of the Statue of Liberty in our harbor, we have concluded to do nothing more at present than to mention the fact.

The illustrated press generally has given views of this impressive structure without number; and these views vary in details and proportions with the individual taste of the artists.

In January, 1884, we gave a scale drawing in elevation from the original official plans; and as an alteration has been since made in the height of the pedestal, we propose to give another elevation to scale as erected. But in the whirl of preparation preceeding the ceremonies of last Thursday, it was simply impossible to obtain the necessary data from the office of Chief Engineer, Gen. Stone, and we must defer its production until this material can be obtained officially.

ONE of the unexpected uses to which natural gas fuel is put is in the manufacture of artificial jewels. The Pittsburg *Dispatch* says that the factories of Belgium and France have had a monopoly in this branch of business heretofore. The basis of these jewels is glass, but the acme of glass-making can only be reached by the use of a hot, clear and steady fuel and this natural gas has furnished in a superative degree. The Pittsburg paper claims that we now lead the world in the production of imitation gems.

THE emigrants from the United Kingdom of Great Britain and Ireland for the first eight months of this year, numbered 161,406; 107,120, or two-thirds, came to this country. 55,467 of these were English, 40,200 Irish and 11,453 were Scotch. British North America received 21,868 immigrants from the United Kingdom or 13½ per cent. of the emigration, leaving about 20 per cent. for Australia and all other colonies and countries. Either times are not hard here in comparison with other countries, or a good many people have made a mistake.

MR. CHARLES E. ENDICOTT, in a letter to the Boston *Advertiser*, gives the following, as the yearly increased production of wealth:—

United States	$825,000,000
France	375,000,000
Great Britain	325,000,000
Germany	200,000,000
Other countries	725,000,000
Total annual production of wealth	$2,450,000,000

These figures agree very closely with Mulhall's statistics, and his statement that the United States add over one third to the annual increase of the world's wealth.

The entire wealth of the United States he estimates as $43,642,000,000. In 1860, omitting slaves, it was $16,157,000,000. We now, undoubtedly, lead all nations as producers, and, consequently, in the aggregate wealth of the country, though Great Britain, not the United Kingdom, exceeds us in the average wealth per capita.

The Strength of Our Elevated Railways.

Manager Hain, of the New York elevated railway system, writes to the *Sun* that the patrons of these roads need have no fear that increased traffic will in anyway lessen the stability of the structure. He states the case as follows:

There are thirty-two miles of double track road in the system, divided into independent spans of 40 feet each, supported by transverse girders resting on wrought-iron columns. The material used has a tensile strength of not less than 50,000 pounds per square inch, and the Rapid Transit Act limits the strains on the compression and tension members to 9,000 pounds per square inch, the shearing strain on rivets to 7,000 pounds, and the maximum deflection of a girder under load to be not greater than 1-1500 of its length; the factor of safety of the columns to be five and the load upon the foundations not to exceed 2,000 pounds to the square foot.

Mr. Hain says that with the increased weight of the engines now in use, necessary to draw five loaded cars, in no case is any portion of the strain anyway near the limits above referred to. He quotes from Fairbairn to the effect that a light plate girder of 20 feet span subjected to 100 daily deflections equal to one-quarter of its breaking load will last 300 years, and that with the safety factors used on the elevated structures, there is no possible danger from vibration.

He further states that the pin-connected Sixth avenue structure has been re-enforced within the last four years to fit it for the type of engine used; that the Third avenue line is undergoing the same additions, and that the Second avenue line was originally designed for much heavier engines than any now in use.

In March, 1885, the roads were thoroughly examined by a board of expert engineers and bridge-builders and were reported as in better condition than when the structure was first opened for business. Prof. Thurston, then of the Stevens' Institute, made tests of the iron and reported no signs of crystalization and expressed surprise at the good quality of the iron submitted to him.

A large force of men are employed day and night in inspecting the track and structure, and the fifty and sixty-pound steel rail is now being replaced by a steel rail weighing seventy pounds per yard.

Steam Expansion and Weight of Engines and Boilers.

In a very interesting and important paper relating to high speed marine engines, read recently by Messrs. F. C. Marshall and R. L. Weighton, before the Northeast Coast Institution of Engineers and Shipbuilders, some striking facts are presented as to how the weight of machinery is affected by the number of times to which the steam is expanded.

It is evident that the amount of work ob-

tained from each pound of water evaporated by the boilers depends upon the number of times to which the steam is expanded in the engine. The greater the degree of expansion, the greater the amount of work obtained per pound of water evaporated; therefore the smaller and lighter the boilers, but the larger and heavier the engine for a given amount of horse power.

For every particular case of boiler pressure and type of machinery, there must therefore be some degree of expansion, any addition to which will entail an increase of engine weight, which will be greater than the consequent diminution of boiler weight; and any lessening of which will entail an increase of boiler weight, which will be greater than the consequent diminution of engine weight.

Reasoning on this basis, Messrs. Marshall and Weighton have calculated the following table, showing the variation of weight with the number of expansions in a given type of marine engine of high speed proportions, driven by boiler steam pressure of 125 pounds above the atmosphere:—

Number of Expansions	Piston Areas to Give Equal Power	Steam Used to Give Equal Power (also Coal in sumption),	Weight of Engines.	Weight of Boilers, Including Water.	Total Weight, Including Water.
0	1.	1.	6.1	9.9	103
3	1.44	.48	8.67	44.5	53.2
4	1.71	.4375	10.4	40.15	50.55
5	1.97	.394	12.1	36.86	48.96
6	2.23	.376	13.6	34.87	48.47
7	2.47	.3638	15.06	33.11	48.17
8	2.731	.3414	16.6	32.1	48.7
9	2.974	.3301	18.1	31.0	49.1
10	3.221	.3221	19.6	30.2	49.8
11	3.415	.3104	20.8	29.2	50.0
12	3.710	.3091	22.6	29.0	51.6

In figuring this table, at no expansion at all, the piston area and quantity of steam used were taken as unity, and the weight as 100, and the rest of the figures are proportional to these. From this it would appear that the most economical weight—expansion in the assumed conditions, is about 7. The table shows how the engine increases with the number of expansions, and how the boiler diminishes until a point is reached, in this case 7 expansions, beyond which the increase of engine weight exceeds the diminution of boiler weight. The third column shows also the coal consumption, which diminishes as the expansion increases, but proportionately less with the higher expansions.

We may add that 7 to 8 expansions are the figures adopted in the trans-Atlantic service of our leading ocean steamers, and which have apparently proved most economical, the freight value of fuel being involved in the consideration, and also the increased displacement and resistance caused by increased weight of machinery, water and fuel, consequent upon too high or too low a rate of expansion.

In stationary condensing engines, running with an initial pressure of steam of 125 pounds above the atmosphere, the most economical rate of expansion also approaches 7, when the economy is based, as it properly should be, on the current money expense of developing the horse power, such expense being the sum of cost of fuel, interest, etc., on first cost, attendance and the like.

The Fire Record for Three Months in New York.

The report of the Fire Department of New York for the quarter year ending September 30, shows the force and apparatus on hand in this city to combat fire and the frequency with which these are called upon to act.

The total number of officers and men in the department is 899; there are 61 steam fire-engines, 122 horses, 31 four-wheel tenders with 61 horses, 31 two-wheel tenders with 35 horses, 25 hook-and-ladder trucks with 55 horses: the total of horses is 273. The total number of alarms in the quarter was 634, with 576 actual fires, the remainder being either unnecessary or merely indications of fire. Of the total of 558 house fires, 522 were confined to the point of starting, 23 others confined to the building, and only 13 extended to other buildings. As showing the extent of the fires, 407 were extinguished by buckets of water, etc., 105 by one engine stream, and the remainder required two or three engine streams, only 18 of these more than three engine streams.

Monday seems to be the day of the week most prolific in fires, the number being 107 on that day as against 85 on Tuesday and 84 on Sunday the next higher in the record. Between the hours of 12 midnight and 12 noon 177 fires occurred, and from 12 midnight to 6 A. M., 82 fires out of the total. There were 250 fires in July, 181 in August and 145 in September.

The total quantity of water used at fires was estimated as follows:

	Gallons.
By land-engines, including water drawn from rivers	5,116,500
By floating-engines, water entirely from rivers	202 500
Total	5,319,000

The total number of persons injured at fires in the quarter was 56, of this number six were fatal; no lives were lost. The estimated loss on buildings and contents was $711,516, covered by an estimated insurance of $5,120,203. The estimated uninsured loss was $107,315, and the average loss per fire in the three months was $1,235.28. In regard to extent of loss, 44 per cent. of all the fires showed a loss of less than $10; 23 per cent. less than $50; 10 per cent. less than $100; 17 per cent. less than $1,000, and 5 per cent. less than $5,000. There was one $200,000 fire in July.

Respecting the origin and cause of the fire, the report states that in fires arising from illuminating mediums, 45 were accidental and 82 from carelessness; in manufacturing, 78 were accidental, 23 from carelessness and 4 from defective building construction; in the miscellaneous list, 40 were accidents and 177 from carelessness. The grand total gives 163 accidental fires, 282 from carelessness, 23 from defective building construction; 82 from mischievousness, 5 malicious, 8 incendiarism, and 13 not ascertained. In the careless and mischievous lists, 47 fires are charged to cigars and pipes, 38 to fire-crackers and 35 to children playing with matches; 18 fires are charged to defective flues and chimneys.

During the quarter, a total of 995 plans and specifications for new buildings, at an estimated cost of $12,245,345, were filed and acted upon. Of these, 280 were dwelling houses of an aggregate cost of $3,223,400 · 259 were flats to cost $4,786,700, and 123 tenement-houses to cost $1,403,400. In addition to these there were 591 permits issued for alterations, valued at $1,301,408.

Mineral Products of the United States, 1885.

From advance sheets of the forthcoming report of the U. S. Geological Survey, we make the following condensed statement of the mineral production of the United States for the year 1885:—

The total coal production, excluding the colliery consumption, was 95,834,705 long tons, valued at $152,915,108, of this 32,265,421 was Pennsylvania anthracite valued at $72,274,544; and the other coal including bituminous, brown coal, lignite and small lots of anthracite produced outside of Pennsylvania, amounted to 63,569,284 long tons, valued at $80,640,564. The total absolute coal production of all kinds was 99,069,216 tons, and the total production of anthracite, including mine consumption, was 1,052,792 tons in excess of the out-put for 1884, and its value was $10,320,436 greater. The total production for 1885 shows a net loss in tonnage over 1884 of 7,837,079 tons, but a gain in value of $15,251,018, the total value being about the same as for 1883.

The coke production was 5,106,696 short tons, valued at the ovens at $7,629,118. Pennsylvania produced 78 per cent. of this; the remainder came from fourteen States and Territories. The production of 1885 is a gain on that of 1884, but does not reach within 360,000 tons the out-put for 1883.

The total petroleum production was 21,842,041 barrels of forty-two gallons; of which Pennsylvania and New York fields produced 20,776,041 barrels. The total value of this petroleum at 87½ cents per barrel was $19,193,694. The production shows a decrease of 2,247,717 barrels, and $1,282,600 in value, from 1884.

No record is kept of the yield of natural gas in cubic feet, but the amount of coal displaced by gas in 1885 was 3,161,600 tons valued at $4,854,200. The yield has increased ten-fold since 1883.

The principal iron statistics are: Domestic iron consumed, 7,600,000 long tons; value at mines $19,000,000. Imported iron ore consumed, 39,786; total iron ore consumed, 7,990,786 long tons; pig-iron made 4,044,526 tons; value at furnace, $64,712,400, or $9,049,224 less than in 1884. The total spot value of all iron and steel in the first stage of manufacture, excluding all duplications, was $93,000,000, a decline of $14,000,000 from 1884.

The mint authorities estimate the value of the gold produced in 1885 at $31,801,000, an increase of $1,001,000 over 1884. The silver product is estimated at $51,600,000, an increase of $2,800,000 over 1884.

The copper production was 170,962,607 pounds, valued at New York at $18,292,999, at an average price of 10.7/8 cents per pound. This is an increase in value of $503,312 over 1884.

The lead produced amounted to 129,412 short tons, valued at the Atlantic coast at $10,469,431. The production of white-lead is estimated at 60,000 short tons, valued at $6,300,000.

Metallic zinc produced amounted to 40,688 short tons, worth $3,539,856. Zinc was also made from the ore directly into zinc-oxide to the extent of 15,000 tons valued at $1,050,000.

Quicksilver production equalled 32,073 flasks (76½ pounds net) worth $979,189; 245,504 pounds of metallic nickel were mined, worth $169,397; manganese ores, 23,258 long tons, worth $190,281; chrome iron ore, 2,700 long tons; "black tin" ore from the Etta mine in Dakota, 200 tons, and aluminum 3,400 ounces, worth $2,550.

The value of building stone produced was $19,000,000, about the same as in 1884. Brick and tile are estimated at $35,000,000. Lime was produced to the extent of 40,000,000 barrels worth 50 cents per barrel at the kilns.

The production of cement from natural rock increased to 4,000,000 barrels of 300 pounds each, but was valued at only $3,-

200,000. Artificial Portland cement amounted to 150,000 barrels of 400 pounds each, valued at $292,500.

In a summary the total metallic product of the United States for 1885 is valued at $181,589,365. The non-metallic products in the same summary are valued at $239,431,991. Including the estimated value of mineral products unspecified (placed at $7,500,000) the grand total foots up to $428,521,356.

The Proposed Russian Oil Pipe Line.

The *Pall Mall Gazette*, of Oct., 8, says that the Russian government has completed a scheme for an oil-pipe line from Baku to the Black Sea, a distance of nearly 600 miles; and it is willing that about 400 miles of this line should be constructed by the country acquiring the concession. This lucrative project has already brought the Paris Rothschilds and the Belgian firm of Cockerill & Co., into the field as competitors. But the Russians are leaving the matter still open for the "lowest offer." It would require about $10,000,000 capital, and excluding the Nobel Brothers, there are no interested Russian firms rich enough to advance the funds required, hence the invitation to foreign capitalists.

The line will start from Baku, but the exact terminal on the Black Sea is still to be fixed upon. It will probably be at Poti and not Batoum. The pipe will be required to pass 160,000,000 gallons of oil annually. As soon as the traffic reaches 90 per cent. of this a second pipe must be laid and be ready for use within two years. Three years will be allowed for laying the first oil-conduit.

The concession is to be for twenty years, but the State will give no guarantee, nor will it allow the company to own oil wells or refineries. Over crown-lands the right-of-way will be donated, on other lands it will be subject to the same privileges as railways. One-third of the pipe must be obtained in Russia, but this clause will not be insisted upon. The tariff to be charged on oil pumped through the line is ten or eleven *copecks* the *pood*, or a little more than one cent per gallon.

The engineering obstacles are few; the ascent to the Suram Pass (3,200 feet above the sea) is somewhat sharp and will require frequent pumping stations, thence the oil will flow by gravity to the Black sea. If, as stated, oil can now be bought by the tens of millions of gallons at Baku for about two cents per gallon, run to the sea for another cent and transported to London in tank-ships for but little more, there will probably be a tumble in American prices.

The Time Englishmen Spend in Railway Trains.

The *Pall Mall Gazette* has been making a curious estimate of the time spent in railway trains by the English travelling public. It assumes that each of the 28,233,996 first-class travellers in 1885 paid an average fare of two shillings, and that at two pence a mile and thirty-six miles per hour this represented an average of twenty minutes of time. Figuring on this basis, and properly modifying rate of fare and speed of travel to suit the three classes of travellers, the *Gazette* estimates that the first-class passengers consumed in total 8,411,332 hours; the 55,315,478 second-class, 11,797,091, and the 537,581,714 third-class, 127,227,672 hours. This is a total of 16.945 years for the travellers in England and Wales alone in 1855.

Practically worthless as such an estimate would be, it would still be curiously interesting to find out how much time New Yorkers spend on the elevated and surface roads of this city. A resident of Harlem, for example, who uses the elevated road daily to get to business down-town, would spend about nineteen days of twenty-four hours each in the year on the rail, or 6 per cent. of his working time. And estimating that each of the 120,000,000 people using the elevated railways of this city in the last year, averaged only twenty minutes per day in the cars, it would take one man about 454 years of 365 days each to do the same work. Or, if he travelled ten hours per day and on week days only, it would require more than 1,300 years of individual labor.

Were the estimate carried to the general railroad travel of this country, the figures would doubtless assume astonishing proportions, as Americans far exceed any other nation in the world in their common use of the railways.

Sugar as an Ingredient in Mortar.

Mr. Thomson Hankey, one of the most extensive builders in London, calls attention to the fact that by experiments recently made sugar has been proven to be a valuable ingredient in mortar and cement, having strong binding qualities. The proportions given by a "gentleman well known in the scientific world," are equal quantities of finely powdered common lime and good brown sugar, mixed with water.

The Colonies and India (London) is responsible for the above statement, and further that this new cement has been tried in mending the broken tracery of a window in Peterborough Cathedral. It is said to hold firmly to glass and is equal to Portland cement in strength. We have heard of a certain kind of "Sugar" being used to bind corrupt officials to an unlawful bargain in connection with some of our great engineering works; but this latest application of the saccharine product is new to us and we give it for what it is worth.

Historical Sketch of the Institution of Civil Engineers.

In the report of the Council of the Institution of Civil Engineers (England) for the session 1885-86, is an interesting historical sketch of the Institution and its Proceedings. We make a brief abstract showing the origin and growth of this, the most influential engineering society in the world.

The honor of having originated the Institution is often erroneously assigned to Smeaton or Telford. Smeaton did found a society of engineers, still existing, in 1771, but died many years before the Institution of Engineers was thought of, and Telford only joined the Institution after it had been established.

The true founders of this society, were six young men, who, in 1817, resolved by this means to promote regular intercourse among persons engaged in the profession of civil engineering so that they might mutually benefit by an interchange of individual observation and experience. These men were Wm. Maudsley, Joshua Field, Henry R. Palmer, James Jones, Charles Collinge and James Ashwell.

They held their first formal meeting on Jan. 2, 1818, and other engineers joining, rules were framed for their government. The growing value of such meetings induced them to attempt to obtain the patronage of some eminent and popular professional man and accordingly on Jan. 23, 1820 they resolved to respectful request Thomas Telford, C.E., to accept the office of President of the society. Telford had never heard of the society up to this time, but appreciating, with characteristic judgement, the value of such an institution, he at once accepted, and on March 21, 1820, he was formally installed.

Telford's name gave an impulse to the progress of the society, and it grew so rapidly under his fostering care that on June 3, 1828, it was chartered under the Great Seal as the INSTITUTION OF CIVIL ENGINEERS. Telford remained as its President until his death in 1834, and late in his life as he drew away from the toils of business, his attention became more and more concentrated upon this society. He was succeeded as President by Mr. James Walker in 1835.

In 1836 the first volume of transactions was published, a handsome quarto of 325 pages elaborately illustrated. In 1837 the publication of the smaller minutes of proceedings in octavo was commenced; and in 1838 a second volume of quarto transactions appeared and in 1842, a third and the last of these transactions in quarto form. Owing to the expensive form of these publications it was decided that from March 12, 1844, the papers should be published in octavo in full with the illustrations, and from then they have been regularly continued in this form.

In 1846 the by-laws were changed so that no Member should be eligible for the office of President for more than two years consecutively, and at the expiration of two years he should not be re-eligible for three years. This was done to overcome an implied understanding that the President held office for life, Mr. Telford having been in the chair for 14 years and his successor for 10 years. In the same year other changes were made more accurately defining the qualifications of candidates for admission.

The Institution first occupied hired rooms at 15 Buckingham street, Adelphi; but at Christmas, 1838, it entered upon the premises now occupied on Great George street. In 1846 this house was enlarged at a cost of £4,350, met by an assessment upon the members. In June, 1856, Mr. Manby, who had been Secretary for seventeen years, resigned, on account of professional engagements; but he continued to act gratuitously and was subsequently appointed Honorary Secretary and held his position until his death on July 31, 1884. Mr. James Forrest, the present Secretary, who had been more or less intimately connected with the Institution since 1842, was appointed Assistant Secretary in 1856; his position being changed to that of Secretary on January 3, 1860.

In 1865, finding again that their accommodations were insufficient, action was taken looking towards a purchase of the property at 15 and 16 Great George street, at a cost of £66,000. This amount was to be raised by subscription, partly out of the funds, and partly by mortgage. After several special meetings and, after subscriptions amounting to £25,000 had been raised, it was decided that the matter be dropped and the subscription list be cancelled. In 1867 it was resolved to enlarge the building on the existing site, and a lease for ninety-nine years was entered into; the cost, inclusive of furniture, amounted to nearly £18,000. To meet this expenditure, the Council decided to realize on unconditional bequests and sell all of the Institution Investments excepting a sum of £3,000.

In 1870 the "Minutes of Proceedings" were enlarged to two volumes for each Session instead of one as before. In 1874-75, the publication of "Other Selected Papers" was commenced, and at the same time this publication was enlarged with a third section of Minutes, entitled "Abstracts of Papers in Foreign Transactions and Periodicals." The Minutes were then enlarged to four volumes annually, a change involving a great increase of expense, a staff of thirty or forty abstractors

and an addition to the Secretary's staff. In December, 1878, the class of "Associate Member" was founded, to provide for engineers who were not fully entitled to the grade of Corporate Member and yet objected to being classified, as formerly, with Associates who according to the constitution are "not necessarily civil engineers by profession." Since 1880, there has been an understanding that the President shall hold office for one year only, though there has been no change in the by-laws on the subject.

The use of a certain abbreviated designation corresponding to the class to which the member belongs is acknowledged as a right by the Institution; but the use of the simple letters "C. E." is expressly discountenanced by the Institution, as not founded on any qualification, and as being calculated to mislead.

The growth of the Institution in numbers is shown by the following statement in decades:—In 1836 there were 238 members of all classes; in 1846, 600; in 1856, 797; in 1866, 1339; in 1876, 2,844, and in 1886, there were twenty Honorary Members, 1,542 Members, 2,111 Associate Members, 501 Associates, and 926 students, a total of 5,100 of all classes.

The annual dues from the various classes are as follows, residents being classed as those residing within ten miles of the general Post Office in London:

	Member	Associate Mem. and Associate	Student
	£. s. d.	£. s. d.	£. s. d.
Resident	4. 4. 0	3. 3. 0	2. 2. 0
Non-Resident	3. 3. 0	2.12. 6	1. 11. 6

Every new Member and Associate, on admission, must pay a fee of ten guineas. The receipts of the Institution from all sources in 1886 amounted to £19,945. The Institution has received since 1860 unconditional bequests to the amount of £8,987, 11*s*, 9*d*. The cost of the Proceedings for 1884-85, including postage, was about £6,500.

The present house contains a Meeting Room, 60 feet by 40 feet by 30 feet high which will accommodate 450 persons; below this is a Reading, a Writing room and a Council room, and the front of the house is chiefly occupied by the Library and the offices of the staff. The Library is too small for the books already accumulated and some of these are now inaccessible. The library now contains about 21,000 volumes, occupying 2,238 lineal feet of shelving. The catalogue is as yet in manuscript only.

The nominal capital of the several Trust Funds, including unexpended dividends, is £14,642, 13*s*, 10*d*.; which in the year ending March 31, 1886, produced an income £427 11*s* 9*d*. While the receipts of of the Institution for 1885-86 were £19,945, 15*s* 9*d*, as stated above, the total expenditure, including an investment on capital account, was £19,113, 17*s*. 1*d*.; the general expenses amounted to £15,487.

THE business of Water-Works Construction is booming. Since the last issue of Statistical Tables of American Water-Works in 1885, the number of places having a public water supply system has increased from 969 to 1,400; this does not make any account of the numerous and costly extensions of old works, made necessary by the growth of the towns and cities of the country, and which must continue on even a more extensive scale in the near future. The Statistical Tables of American Water Works, gives the list of the new works, and it also exhibits the conditions resulting from extensions.

PERSONAL

COUNT FERDINAND DE LESSEPS, is at present in this city, as one of the representatives of the French nation at the unveiling of the Statue of Liberty. The Chamber of Commerce of New York City, gave a reception in his honor at the Rooms of the Chambers on Friday, Oct. 29.

J. C. HOADLEY, widely known as a mechanical engineer, inventor, author and expert, died suddenly at Boston, last week. We expect to give further details of his useful life in a later issue.

Mexican Sanitary Engineering.

GUANAJUATO, MEXICO, October 5, 1886.

EDITOR ENGINEERING NEWS:

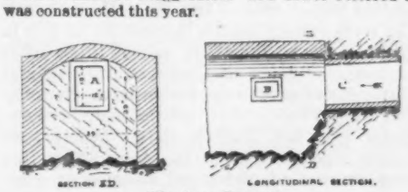
I have read with interest the article by Mr. Edward Sawyer, in "Guanajuato, and its death rate of 76 per one thousand," published in your issue of the 25th ult. Mr. Sawyer describes, with remarkable accuracy and clearness, the general topographical features of the city, but is led into several false conclusions, unavoidable to a transient observer forming opinions during a flying trip. The cemetery he refers to as a possible source of contamination to the water supply, is in an entirely different drainage area from that furnishing the reservoir, and some two miles distant. The intervening ridges are impervious rock, any subterranean communication, as in the Lausanne case in Europe where the germs of typhoid fever were carried several miles through a porous formation, as clearly proved by chemical tests, being impossible.

Instead of the water supply being impounded in one reservoir there are two, located in the same mountain gorge. The great local holiday of the year is "*La fiesta de la Presa*"—"the feast of the reservoir," when the water in the lower reservoir is discharged, a sufficient supply having accumulated in the upper one to guard against a water famine. This generally occurs about the 20th of June, at the commencement of the rainy season. Each year therefore the water is entirely renewed. No provision is made for "blowing off" the mains, however, which should be done. How often the *deposit* in the reservoirs is removed depends on circumstances. Last year a cloud burst conveyed from the surrounding mountain sides a large amount of *debris* and the reservoir was thoroughly cleaned. This year has been very unhealthy. By municipal ordinance no houses are allowed on the water shed supplying the reservoir.

The reservoir referred to by Mr. Sawyer, located in front of the Governor's residence, has no connection with the water service.

While the water is totally insufficient in quantity, and not what we would consider, in the United States, suitable in quality, its bad feature is, principally, a large amount of earthy matter held in suspension, which is removed by its passage through stone filters, in almost universal use. It also has the disagreeable features met in water stored in reservoirs without any feeders during the long dry season, but I doubt if the great mortality can be attributed directly to the use of this water for domestic purposes. The well-to-do classes prefer spring water, which is sold by carriers, and many houses are supplied with cisterns. The city has been threatened with a water famine many times.

The absence of an abundant water supply, however, renders an efficient sewerage system impossible. The class of sewers adopted in construction will surprise your readers. That such forms should be allowed in the nineteenth century is hard to believe. The following sketch will make the terrible conditions created by expenditure of the public money, clear. The dimensions are estimated from inspection, but are sufficiently accurate and not exaggerated. The sewer referred to was constructed this year.



Mexican Sewers.

The house drains are parallelograms in section, as shown at *B*, about 8 inches wide by 4 inches high, the worst possible form, and enter the sewer at random levels and at varying angles with the line of flow. The sewer shown in section *D E* was built to relieve the adjoining territory from storm water, but house drains are allowed to enter it. The bottom is in ledge, left rough. The excavation was made with wedges, no blasting being resorted to. The sewer shown in end elevation at *A* and longitudinal section at *C* is used for house drainage, and built of stone slabs. A 4-inch pipe would carry all the sewage in either section of sewer with a slight depth of flow. The sewage collects during the seven months of the dry season. No flushing is attempted. It would be far better, in a sanitary point of view, to distribute the sewage on the surface where it would be freely exposed to light and air. It may seem strange to the casual reader to learn that the *rainy* season is by far the most unhealthy portion of the year I attribute this to the more active evaporation caused by moisture, and the agitation of the accumulated filth The following table shows the average death rate per month for twelve years, from 1874 to 1885 inclusive:—

Months.	Jan.	Feb.	Mch.	April	May	June	July	Aug	Sept	Oct.	Nov.	Dec.	Total.
Deaths.	267	258	304	357	392	431	460	415	327	298	265	257	4031

Total deaths for twelve years 48,373, based on an estimated population of 53,000. The rainy season includes June, July, August, September and October.

The theory that disease germs may be disseminated by means of *adobes*, made from deposits in the river bed, is not a new one. I have several times discussed this point with an intelligent physician, who inclines to the belief that such is the case. It must be remembered, however, Guanajuato is a very old city. The mines of the district have been worked since 1548. It seems to me, even if the germs of disease were active in the fresh adobes, they must have long since become innocuous in the old buildings. As zymotic disease is more prevalent in the ancient portion of the city, I cannot attribute the evil, to any great extent, to adobe construction. I think more stress should be laid on resultant evils from cobble stone street pavements universally used. The filth of centuries is deposited in the subsoil, and yearly the interstices between the stones are filled with filth, subject to rapid evaporation during the rainy season.

If any of your readers desire more detailed information in regard to sanitary conditions here, I would refer them to the Mexican *Financier*, of July 10th and 17th. This journal is printed in English and Spanish. The New York office is No. 81 New street; Boston office, Mason building, Liberty square, and it is on file in the leading clubs and reading rooms in the United States It furnishes the most reliable news on engineering projects published in Mexico.

C. H. M. BLAKE.

Stand Pipes.

EDITOR OF ENGINEERING NEWS:

If I understand the U. S. Government rules relating to steam boilers, the allowance of strain for single riveted longitudinal seams is $\frac{1}{6}$ the ultimate strength of the plate, applying this rule to the Sandusky stand pipe, the maximum pressure allowed on the lower ring $\frac{5}{8}$-inch thick of say 60,000 T. S. steel would be,

$$\frac{0.625 \times 10{,}000}{150} = 41.7 \text{ pounds per}$$

square inch, equivalent to a head of 96.25 feet of water, or less than one half the head which the ring is supposed to bear.

If the vertical seams are double riveted which they probably are, then the Government rules would allow an addition of 20 per cent., or a total pressure of 50 pounds equivalent to a head of 115.4 feet instead of 208 feet.

The U. S. Treasury regulations allow for single riveted longitudinal seams with steel or iron of 60,000 T. S. a maximum strain of 10,000 per square inch of section of solid plate, and for drilled, and double riveted work 12,000 pounds per square inch of section of solid plate, and not 23,000 pounds as stated by Mr. Ward.

Under U. S. Government rules a stand pipe 200 feet high and 20 feet diameter with drilled and double riveted vertical joints should have as the thickness of the plates in the lower ring, with 60,000 T. S. steel or iron—0.868 inch instead of 0.459 or 0.551 inch (see R. S. 4433) as Mr. Ward puts it in his letter of the 15th ult.

In view of the probable importance of a stand pipe to the water system of which it is a part, it seems to me that the factor of safety should be sufficient to set aside the possibility of failure and for this purpose a factor of safety of less than three should not be used.

Taking the value of the material at 60,000 T. S. with double riveted vertical seams and a factor of safety of three, the thickness of plates in the bottom ring should be,

$$\frac{208 \times 150 \times 3}{2.308 \times 0.75 \times 60{,}000} = 0.90 \text{ inch}$$

I have often been called upon to examine boilers which have been ruptured by steam pressure, and have been struck by the fact that the breaks are oftener found in the solid sheet than in the double riveted joints, from which I have been led to believe that the strength of a double rivetted joint, when the rivet holes come fair and the rivets fill the holes, can safely be taken at three-fourths the strength of the plate.

I have also noticed in testing so-called 60,000 T. S. steel boiler plate that the tensile strength often exceeds 80,000 pounds per square inch of section, and with such material in the Sandusky stand pipe the factor of safety with 208 feet head on bottom ring $\frac{5}{8}$-inch thick, would be 2.66. With 60,000 T. S. plates, and full head in the stand pipe equivalent to a strain of 22,333 pounds per square inch of section of solid plate or 30,000 pounds on the joint, I should regard the load as too near the danger line for comfort.

The lower rings in a stand pipe have, as the greatest load which may come upon them, the pressure of the hydrostatic column, and when proportioned to meet this will be sufficient for all other strains. But the upper rings, while of a thickness sufficient for the hydrostatic load, may be so light as to collapse under moderate wind pressure should the water be below the ring and an extra thickness must be provided to meet this condition. It seems to me, however, that this extra thickness should bear some relation to the diameter of the stand pipe and not be a constant (as proposed by Mr. Ward) for all diameters.

Taking Mr. Ward's formula with 60,000 T. S. steel plate, and applying it to stand pipes 208 feet high of 5, 10, 20, and 30 feet diameters, we have the following results:—

Diameters, feet	5	10	20	30
Thickness of lower ring, inch	0.254	0.358	0.566	0.774
Strain per square inch of section of solid plate—pounds	10,644	15,104	19,107	20,960
Strain per square inch of section at joint—pounds	14,192	20,138	25,467	27,947
Factor of safety	4.23	2.97	2.36	2.15

A formula which gives a factor of safety of (4) with a 5 foot diameter of stand pipe and a factor of safety of (2) with a 30-foot diameter of stand pipe; seems to me to be radically wrong, because the highest factor of safety (if there should be any difference) should be found in that stand pipe which represents the largest investment and upon which the greatest reliance is placed; evidently the larger stand pipe, which not only determines the head but in case of sudden fire demands is intended to serve as a reservoir.

Very Respectfully,

JOHN W. HILL.

CINCINNATI, October 25, 1886.

EVERY civil engineer who is interested in the construction of water-works and who wishes other people to know that fact in view of future possibilities of employment, ought to have his name appear in the forthcoming Third Issue of the Statistical Tables of American Water-works, now in the hands of the printer and being rapidly pushed to completion.

St. Louis Engineers' Club.

The club met at 8 P. M., October 20th, in the directors' room, Mercantile Library, President McMath in the chair, fourteen members and two visitors present.

The minutes of the meetings of April 14th and June 16th were read and approved, also the report of the meeting of the executive committee on September 1st.

There being no regular programme prepared for the evening, President McMath called the attention of the club to that part of the proceedings of the recent meeting of the American Society of Civil Engineers referring to the advisability of a closer union of engineering societies. The secretary read extracts from the published proceedings in which the American Society had directed inquiries to be made as to the sentiment of its own members and that of the engineering societies. No official communication having reached the club, the matter was discussed in an informal way by Messrs. Moore, Johnson, Seddon, McMath and Potter. The sentiment of the club seemed to be opposed to any action that might neceessitate a change in existing local organizations, but in favor of a union of publications. Prof. Johnson explained the failure of a raised series of seats at Washington University. Prof. Potter spoke on the superiority of the steel nail as now made.

It was moved that the president fill up the membership of the Committee on Smoke Prevention and report his action to the next meeting of the club; carried. Adjourned subject to the call of the president.

W. H. BRYAN, Secretary.

Some of the Engineering Features of Illinois Drainage.*

BY I. O. BAKER, MEM. OF THE WESTERN SOC. OF ENG.

Having during the past summer given considerable attention in one way and another to drainage matters, the writer thought that possibly he might be able to gather up a few items which would be of interest to the members of this Society. It would be difficult for one who has not investigated the matter, or who has not mingled freely with the agricultural community, to appreciate the magnitude of the drainage craze which has taken possession of the people of this State. For a number of years, large sums have been spent in tile drainage, in the year 1833, the last year for which the record is made up, nearly 12,000 miles were laid; but very recently the drainage problem has taken a new phase. Within a few years past attention has been directed to the drainage of numerous comparatively large flat tracts of land which it had been considered impossible to drain. This article refers only to the latter.

A recent article in *Science* states that there are 50,000 square miles of swamp land in the United States east of the Mississippi; but if the term swamp land is interpreted as it is in Illinois, there must be many times that amount. By act of Congress, the General Government gave to the States all the "swamp and overflowed lands" within their borders; under this act, Illinois claims nearly 3,500 square miles. Although there is nothing like that amount of undrained swamps or overflowed land now in the State, yet the amount of undrained land which will require construction of large ditches for outlets is considerably larger. Judging from one or two counties with which the writer is pretty well acquainted it may possibly be twice as great. The drainage enterprises of Illinois properly are not the drainage of swamps but the cutting of large canals to serve as outlets for tile drainage. The area to be drained frequently includes swamp tracts, but by far the larger portion is already partially drained. In the estimate in the article in *Science*, Illinois was probably credited with comparatively a small amount of swamp land.

According to that article half of the estimated swamp lands of the United States consists of tide-water marshes along the South Atlantic and Gulf coasts, and doubtless only a small part of this was assigned to Florida; yet there is a single drainage scheme now in progress in the southern half of that State which will redeem for agricultural purposes 17,000 square miles. This is given to show that there is a large amount of land in the United States, in addition to the swamps, which is now too wet for agricultural purposes, and which can be greatly improved by proper drainage. For reasons not difficult to discover, a large part of this area will soon be won to a much more successful agriculture. When the work of redemption is commenced the services of the engineer will be called into requisition. A word to the wise!

There is one respect in which the drainage enterprises of Illinois differ from any other of which the writer knows. In this State the land to be drained is owned in comparatively small tracts, and any drainage scheme of the kind under discussion will affect a number of proprietors, and consequently the work must be carried on by the combined efforts of a community. In England, in Holland, and in Russia, each of which is noted for the magnitude of its drainage enterprises, the land was owned by the government, and the work of its redemption was carried on at the expense and under the direction of the government. In Florida and Louisiana some large drainage schemes are in progress, but in each case the land to be drained is owned by a single large corporation, which bought the land of the State for a mere song. The drainage districts of Illinois are the only instances in which the co-operation of a community has accomplished results equal to those attained by governments or by wealthy corporations. Although the drainage enterprises of Illinois are neither the most expensive nor the most extensive in the world, they surpass any in the ratio of cost to results.

The work is under the direction of three commissioners, elected annually by the interested land owners. The money is raised by special taxation according to the benefit as assessed by a jury appointed by the court for the purpose. The commissioners are empowered to borrow money and issue bonds. It seems to be generally conceded that the Illinois drainage law is better than that of any other State. The Illinois law seems to be superior in that it gives the three commissioners sole charge, with unlimited authority. Under commissioners with unrestricted powers the work proceeds as a unit, economically and rapidly.

The commissioners "have power to employ a competent civil engineer, if in their opinion the services of an engineer be necessary, who shall thereupon proceed to make such survey and estimates as the said commissioners may direct, and shall make and return to the said commissioners a map or plat of his survey, and a full report of all estimates so required of him." He "shall receive not to exceed $5 per day for the time actually employed." It will be noticed that the engineer is entirely subordinate to the commissioners. The engineer surveys the line of the ditch, takes the levels, draws the profile and plats, and computes the amount of earthwork. Since the ground to be drained is generally a broad flat tract, the ditches are usually quite straight, so

*From the *Journal of The Association of Engineering Societies;* Sept., 1886.

that the location presents but few difficulties. Often the ditch follows the division lines of the land. There is much debate among land owners as to the best form of cross section. As a rule farmers prefer a shallow ditch, on the ground that it will be injured less by stock than one with high banks. This may be all right for small ditches, but unfortunately the same ideas have sometimes prevailed in designing the large outlet canals. However, the introduction of steam machinery has incidentally remedied this partially. No care seems to have been taken to adjust the capacity of the ditch to the probable amount of water to be carried.

The largest ditch in the State is 17½ miles long, 30 feet wide on top at the upper end, and gradually increasing to 60 feet at the lower end, and from 8 to 11 feet deep. There are a number of ditches 30 to 40 feet wide, 6 to 8 feet deep and 10 to 15 miles long. The minimum fall is about 1 foot per mile; and generally the fall is two or three times as much.

The smaller lateral ditches are generally constructed with drag scrapers, although occasionally a road grader is used to construct a flat V ditch which is deepened by running a capstan plow in the bottom of it. Sometimes the capstan plow is used to deepen a scraper ditch. In fact, the capstan plow is employed whenever it is possible, and is a very valuable machine for making small ditches or deepening larger ones. It is said to be peculiar to Illinois. It consists of two triangular mold boards, joined in front and standing at an angle of about 90° with each other; the plow is propelled by two cables attached to capstans driven by oxen or horses. The ordinary capstan ditch is 1 foot on the bottom, 4 to 6 on top, and 2½ to 3½ feet deep. Three men and two teams make 100 rods of such ditch in a day easily. Wings are sometimes attached to the plow, which roll the earth back from the edge of the ditch, leaving a very pretty ditch. One man has attempted to utilize the pressure of the water behind the plow, and thereby be able to construct a much larger ditch. So far it has not been a complete success; when there is a large quantity of earth in the mold board, it shoves along in front of the plow instead of sliding along the mold board and up and out of the ditch.

The larger ditches are generally constructed with steam dredges. The most common form is the boom dredge, *i. e.*, a steam shovel mounted upon a scow. The largest boats are 80 feet long, 36 feet wide, boom 60 feet long, 1¾-yard bucket, 32 horse-power engine, and cuts a ditch 50 feet on the bottom and leaves a berme of 10 to 12 feet. Such a machine will cut about 1,200 yards in ten hours. The smallest dredge cuts a ditch 16 feet wide and from 4 to 6 feet deep. The chief advantage of a steam shovel mounted upon a scow is that it is not stopped by the water; but on the other hand, in a dry season like this, it is sometimes stopped by the lack of water. The chief defect in the steam dredges as operated at present is the great amount of time consumed in raising and lowering the anchoring spuds, and in moving ahead; in a small ditch nearly one-quarter of the time is thus wasted. It does not seem that it would be difficult to remedy this defect.

One contractor is operating a shovel upon a frame or "mud boat" which rests upon the bottom of the finished ditch; it is moved forward by a cable anchored ahead, one end of which is wound up by the engine on the drag. This device seems to entirely remove the above defect.

There is one dredge of the endless chain and bucket type at work in the State. It is similar to the ones at work in Florida and Louisiana. The design seems to be very faulty in several particulars, but it looks as though a machine could be built on this principle which would excel the boom dredges. We have not yet arrived at anything like perfection in the way of machinery for excavating ditches. The capstan ditcher, and both forms of dredges, are susceptible of great improvements. As the results of the present drainage enterprises become better known, and as the increase in population demands the redemption of all swampy lands, and the better development of those already occupied, drainage matters will of necessity receive increased attention, and the services demanded of the engineer will be of a higher order than at present, and the machinery employed will be mor efficient than that now in use.

The price for capstan-ditcher work is the equivalent of four or five cents per cubic yard; it is usually done by the rod. Scraper work is ordinarily from eight to twelve cents, with an occasional job as much as 16 cents. Dredge work ranges from 11 to 17 cents.

LITERATURE.

Journal of the Association of Engineering Societies Sept., 1886,

CONTENTS: "Rainfall Received and Collected on the Water-sheds of Sudbury River and Cochituate and Mystic Lakes," by DEXTER BRACKETT: "The Improvements and Drainage of the Spicket River Valley, Lawrence, Mass., 1883-76," by ARTHUR D. MARBLE; "Foundations of the Garfield Monument, Cleveland, O.," by JAMES RITCHIE and Members of the Engineers Club of Cleveland; "Some of the Engineering Features of Illinois Drainage," by PROF. I. O. BAKER.

In the first of the above papers Mr. Brackett says that on the Sudbury River, with a drainage area of 76 square miles, the average rain-fall for the four months, July to Oct., from 1875 to 1885 was 14.344 inches; the average amount collected, on the same basis as above, was 1.527 inches, or 10.6 per cent. Lake Cochituate has a drainage area of 18.87 square miles; the average rainfall from 1863 to 1885 in the four months, July, to Oct., was 17.01 inches. The rain-fall collected in the same period was 2.96 inches; or, in the last eleven years of the record, 1.89 inches. The Mystic Lake has a water-shed of 27.75 square miles; the average rain-fall in the four months July, Oct., 1878-1885, was 12.89 inches. The rain-fall collected in the same period was 1.89 inches; or 14.7 per cent. The paper goes into the fluctuations from year to year and shows them graphically.

The paper on the drainage of the Spicket River Valley is full of interesting constructive detail together with cost of work done; but it is of such a character that no abstract could do it justice.

THE Members of the Engineer's Club of Cleveland have been discussing the stability of the Garfield Monument in that city. The foundation of this structure is 51x70 feet, supporting a tower of 225 feet high and 40 feet inside diameter; the tower walls are 4¼ feet thick at the bottom and 2¼ feet near the top. The foundation soilis 5 to 6 feet of yellow clay overlying shale strata with a dip of about 10 degrees. The foundation rests on this shale with about one foot of the clay left under the footing courses. Mr. Ritchie in his paper figures a pressure of nine and one-half tons on this clay per square foot: other members gave different figures, among them Mr. W. H. Searles put this pressure at an average of seven tons over the whole foundation and twelve tons under the shaft. As the data for estimating the weight was insufficient to base correct figures upon, the Club finally appointed a committee to investigate from the original plans and the building itself. This committee reported a maximum total weight per square foot of 5,166 tons, and thought this load was sufficient to cause some compression in dry clay, and they had doubts as to the probability of uniform settlement; the committee conclude that it would have been better to have sunk the pit a few feet deeper to the solid shale, and then to have filled this excavation with concrete.

The paper of Mr. Baker is short and we give it in full in this number.

"StraightTips" for Architects, Contractors and Real Estate Owners, comprising lists of Members of the New York Chapter of American Institute of Architects of all the Architects of New York and Newark, of the Members of the Mechanics and Traders' Exchange, and of the Building Material Exchange of New York, and of the Mechanics' and Traders' Exchange of Newark, etc Compiled by T. H. Boorman. New York. 1886. Price 25 cents.

The purpose of the above little book is contained in its title; and it will be found an exceedingly useful investment for all having dealings with the various parties whose names and addresses will be found in this directory. The information is of a nature nowhere else found between two covers.

The Effect of the Charleston Earthquake upon Railroads.

Mr. Earle Sloan, Assistant Geologist, U. S. Geological Survey, has made public the result of his investigations into the Charleston disaster to date. Mr. Sloan thinks that the great earthquake of August 31st was very probably a compound one, proceeding from several foci or points at which some vast terrestrial strain was suddenly removed.

The line of action was northeast to southwest, propagating waves of force which radiated in all directions. The waves from the great focus proceeded southeastwardly and were the first to strike Charleston; and these waves while yet in action were struck by waves from a secondary focus acting from a western direction. These combined waves produced the horizontal, vertical and right and left rotary motions observed.

Mr. Sloan thinks that the peculiar subsoil of Charleston and the want of lateral resistance due to enclosing streams had much to do with the great damage done there, which damage was otherwise out of proportion to the distance of that city from the legitimate line of greatest disurtbance. On this line are found numerous expressions of vast energy; as especially noted in the forcing out of line and pushing forward of railway tracks, the dragging and splitting of cross-ties, breaking of angle-plates and shearing of track-bolts. Where short trestles afforded increased resistance, the accumulated rails had been whipped into sharp and manifold curves; and great gaps had been left in the track as a result of this pushing together of the rails.

At intervening streams the banks seem to have approached each other, jamming the superstructure and bulging up the stringers. At other places, the violent vibrations have detached great masses of earth from the face of bluffs. In regard to the so called "craters" exuding mud and sand, Mr. Sloan says these are susceptible of explanation without crediting them to a plutonic origin. Much of this "lower pine belt" is underlaid by a very shallow water-bearing sandy stratum; the earth-arches over this subterranean system of veins and small reservoirs of water having been crushed by the recent violence, have suddenly applied a pressure upon the fluid mass beneath, and have ejected the sand, mud and water noted. The varying colors reported are due to accidental impurities, or to the inherent colors of the components beneath.

IN A RECENTLY PATENTED SODA-MOTOR, intended for use on street-railways, the process of generating steam is as follows: the caustic soda, which is contained in a reservoir surrounding the steam-boiler, is raised to a high initial temperature by means of jets of burning gas or petroleum, thus evaporating all moisture from the soda. The heat from the soda produces steam in the boiler, which is applied to an ordinary engine; the exhaust steam from the engine is then absorbed by the soda, producing heat sufficient to generate steam, until the soda is supercharged with moisture, when the jets of flame, which in the mean time have been dispensed with, are again ignited to regenerate and reheat the soda. The operation may be repeated continuously. This is a modification of the soda-motors which have been in use several years past in this country and in Europe.—*Science.*

A Drain-Pipe Ditty.

"The Ancient Company of Plumbers has established an office for the registration of all properly-qualified persons belonging to the trade."—Daily Paper.

Scamping Plumber, ere we part
I'll recall your gruesome art!
Still the memory remains
Of your dalliance with the drains.
Here me state, with rapturous joy,
"*Licensed* Plumbers I employ!"

By the typhoid you have spread
From those pipes unstopped with lead!
By your love for leaking taps,
Faulty joints, and bogus "traps!"
Get you trained your trade to know—
Pass your plumbing Little-Go!

By the cistern (whence we drink),
Forming a connecting link
'Twixt the noisome parish sewer
And the humble household ewer,
Hear me thank the Plumbers' Co.
Branding you a public foe!

Scamping Plumber! you have wrought
Evil much by being untaught.
'Spite of amateurish ways,
Knowledge *is* the thing that pays.
If you can't a license show,
Scamping Plumber out you go!—*Punch*.

The Invention of the Sextant.

Dr. J. L. Dreyer points out, in the *Astronomische Nachrichten*, No. 2739, an historical error which has crept into several astronomical works, although it was refuted some fifty years ago by Prof. Rigaud in a series of papers communicated to the *Nautical Magazine*. In the books referred to, it is stated that the principle of the construction of the sextant was communicated to John Hadley by his brother, a Captain Hadley, who had in his possession a sextant given to him by Capt. Godfrey, brother of Thos. Godfrey, of Philadelphia, the real inventor of the instrument. But it appears there never was such a Capt. Hadley. The brothers of John Hadley were—one a barrister, the other a physician; and he himself was not an instrument maker by profession—as has been asserted—but, as an amateur, occupied himself with mechanical pursuits, and was the first to bring the polishing of reflecting telescopes to any perfection.

On May 13, 1731, John Hadley communicated to the Royal Society a description of his reflecting octant; and, after some hesitation, Halley declared himself satisfied that Hadley's idea was quite different from that of Newton, who had invented an instrument founded on the same principle. It is no doubt true that Thomas Godfrey, a glazier of Philadelphia, had invented an instrument of this kind about the year 1730; but the first intelligence of his invention did not reach England before the month of May, 1732, in a letter from James Logan to Halley. Godfrey's instrument was made of wood by Edmund Woolley, a carpenter, about November, 1730, and had been tried on board the ship Truman, of which John Cox was master. The first model of Hadley's octant had, however, been constructed by his brother, George, about the middle of the summer of 1730.

Dr. Percy, President of the Iron and Steel Institute, of England, at the Autumnal Meeting gave in his opening address the following notes on the changes wrought in the cost of manufacture by the introduction of modern machinery:

In open-hearth steel production, 200 tons can now be obtained in the same time that 50 tons were originally turned out. One Nottingham lace machine can do the work of 8,000 women. The planing machine has reduced the cost of true iron surfaces from 12 shillings to a couple of pence per square foot; the work on gold chains which used to cost 30 shillings is now done for 3s. 6d.; a gross of steel pens have fallen in price from £7 to 4d. and one firm uses *weekly* 20 tons of steel plate to be converted into pens.

Annual Meeting of the New England Meteorological Society.

The third annual meeting of the New England Meteorological Society was held at the Institute of Technology, Boston, October 19th. Prof. J. D. Whitney read a paper on "Rainfall Statistics in the United States," considering, especially the statements that have been made concerning the increase of rainfall on the western plains as a result of cultivation of the ground.

Mr. S. A. Eliot read an essay on the 'Relations of forests to rainfall and water-supply.' The common opinion that forests increase and clearings decrease the rainfall, was traced to the authority of eminent writers, based, not on well-kept observations of rainfall under these contrasted conditions, but chiefly on the well-known diminution of stream-flow in cleared districts. This, however, may be due to increased evaporation rather than to decreased evaporation rather than to decreased rainfall. Forests undoubtedly retard evaporation of fallen water, but it is very problematic if they increase the amount that falls.

Mr. Davis added, that, if the causes controlling rainfall be separated into those dependent on and independent of forests, we find that the latter are now powerless to produce forests in forestless countries, such as those around the eastern Mediterranean, and therefore could not have originated the forests once there, unless formerly of different value from now; but, if it be admitted that these non-forest causes vary, the deforesting may be due to natural changes, not to the hand of man.

Several seismoscopes and a series of photographs illustrating the effects of the Charleston earthquake, lent by the U. S. geological survey, were exhibited and explained at the meeting.

In the absence of the director, Professor Upton, an informal report on the work of the year was presented by the secretary. Members now number 110, against 95 last year, and include well-known meteorologists outside of New England. The monthly bulletin has been regularly issued, and recent numbers include reports from 140 to 151 observers, against 123 last year.

Mt. Vernon's Water Supply.

A Report Made by Dr. Chandler and Mr. Martin as to its Character.

A recent report of Dr. C. F. Chandler and Edward W. Martin covering the question as to the character of the water furnished to the village of Mount Vernon by the New York and Mount Vernon Water Company is given below. The action of the village Board of Trustees in accepting this water supply was based on tests made by Dr. Chandler and Mr. Martin, as well as upon a personal examination of the water shed and sources of supply flowing into the company's reservoir and the reservoir itself.

George C. Weiss, M.D., Health Officer, Mount Vernon, N.Y.

Dear Sir: Besides the two personal examinations we have made of the Mount Vernon water supply, including personal inspection of the reservoir and its tributaries, and of the entire water-shed as far as the New Rochelle dam, and the analysis of the samples collected, we have carefully considered all the statements that have thus far appeared on the subject. The statements considered include:

1. The analysis by Prof. S. A. Lattimore, dated August 31.
2. The analysis by H. B. Baldwin, dated Sept. 13 and Sept. 14.
3. The report of Dr. E. F. Brush, dated Oct. 2.
4. The article written by James H. Stebbins, Jr., published Oct. 14.
5. The report of Prof. R. O. Doremus, dated Oct. 14.
6. The report of A. Hallick, Ph. D., dated Oct. 18.

After eliminating the statements which have been found to be absolutely untrue and without foundation, there is nothing contained in any of these documents which would raise a doubt in our minds as to the purity and wholesomeness of this water, or as to its fitness for domestic purposes as a potable water.

The statement that there would arise from the use of this water any danger to the public health is not, in our opinion, supported by a single fact in connection with the reservoir or its sources, or with any analysis thus far presented. Many of the statements adverse to the water are simply ridiculous, and show that the persons making them have had very little experience, if any, in discussing practical questions relating to water supply. This is notably the case in relation to the remarks with regard to colorine and coloride of sodium, and to vegetable matter and humus. We would call your attention to a mistake in the printing of our analysis of Sept. 28. The numbers representing free ammonia and nitrogen in nitrates and nitrites have been transposed.

No occasion could have been selected when defects in the water supply, if any existed, could be more pronounced or more easily detected than the present, owing to the long drought. But even under these unfavorable conditions the verdict must be entirely in favor of the water and its sources.

The unsightly appearance of the upperend of the reservoir is of no consequence from a sanitary point of view. Very respectfully yours,

C. F. Chandler, Ph. D.,
New York, Oct. 19, 1886. Edward W. Martin.

WATER.

Statistical Tables of American Water-Works.—Third Issue.

We are now hard at work on the composition and press-work of the Third Issue of the "Statistical Tables of American Water-Works," compiled by J. J. R. Croes, M. Am. Soc. C. E., and now justly considered a necessity of the Water-Works business interests of this country.

The "First Issue," published in 1883, gave the returns more or less complete, of 803 Water-Works of the United States and Canada: in the "Second Issue," published in 1885, returns—more complete than previously—of 969 water-works were published; in the "Third Issue,' which we hope to have ready by January 1, 1887, there will be returns from about 1,400 Water-Works.

Very important changes have been made in the preparation of the "Tables" for this Issue. The method of arranging in two tables, has been superseded by One Table only. To get even more information than was contained in the former two tables, the pages have been enlarged about 25 per cent. o. surface; the places having water-works have been classified in States, (instead of alphabetically or by population) thus allowing for a quick and easy computation of what has been, and what remains to be, accomplished in each State; the Pressures in pounds for ordinary and for fire purposes have been added as far as obtainable, and will prove of special value to Insurance Companies and to Manufacturers of Water Motors, besides being of general use. We present herewith a sample page of Statistics, in which we think that almost all the information that is of much value has been tabulated under appropriate headings, and so as to be read at sight. There are so many new works that have but exceedingly scanty, or even no returns to make, that there must necessarily be considerable blank space until their first reports are published and compiled.

But with increasing facilities, and more thorough organization for gathering the desired information, it will be found that with each succeeding Issue the "Statistical Tables" are made more full and complete. It is a tedious task at best, and accompanied with difficulties that must be encountered to be appreciated.

These "Statistical Tables" of Water-Works have already become, in certain channels of trade, as important a factor as Poor's Manual has in its speciality of American railways; we invariably send a free copy to every party furnishing information and wherever we think they will promote the construction of works; there has also grown up a very considerable demand for copies among Bankers, and dealers in securities, and to a limited extent among Insurance Companies, who, however, will now find their value enhanced by the addition of Pressure statistics.

In the present Issue we propose to do as heretofore: mail a free copy to every Water Works office in America from which information has been given us, a free copy to every advertiser, and in addition thereto we propose to mail 1,000 copies free to the press; the extra copies will depend on the *advance orders* we will receive before the press-work is completed. The nature of the publication does not warrant the added expense of electrotyping.

These Tables are distributed carefully at the very "life centres" of the Water Works interest; they are *never* thrown away or given away, but are used for constant reference; they are made the convenient memorandum book for marginal notes and additions, to suit

individual owners: they always come to the front when new works are being discussed—we sometimes supply an entire City Council with a free copy—and in a multitude of ways are made useful just where the manufacturers of Water Works Machinery or supplies want them to be. The whole market is supplied as far as the publishers can discover it, and every effort is made to make it so efficient a canvasser that advertisers will value it more with each succeeding issue.

The cost of publication is provided for by the receipts from advertising, the prices for which are given on last pages of this circular.

We think it will pay you to have a card in the forthcoming Issue of Statistical Tables.

Very Respectfully,
ENGINEERING NEWS PUBLISHING COMPANY,
12 Tribune Building, New York.

THE DESTRUCTION OF THE KANKAKEE WATER TOWER.—J. K. Croswell, City Engineer of Kankakee, Ill., furnishes us the following data in regard to the late destruction of the water tower at that place: This tower was built for the Kankakee Water Co., by the Sharon Boiler Works, of Sharon, Pa., for Hinds, Moffat & Co, of Watertown, N. Y., who own the works, the city paying an annual rental for city purposes. It was located in a central part of the city and on almost the highest ground within the city limits, and fifty feet above the pumping station, about one mile distant. The foundation of the tower was stone laid in cement and was 22 feet in diameter. The tower was constructed of boiler iron and was 20 feet internal diameter and 124 feet high. It was built in 31 rings each four feet high, and "thoroughly riveted." The bottom rings were ½ inches thick, diminishing to 5-32-inch at the two top rings. There were six anchors of 2-inch round iron, about 8 feet long in the bottom, secured to the tower by heavy cast-iron plates.

In the fall of the tower these anchors pulled out of the masonry; one broke below the nut at the top, and one at the lower end in the masonry. The tower fell on Oct. 14, during a wind storm the velocity of which was estimated at the time at 60 miles per hour: while in Chicago, 56 miles north, the signal officer put it at 70 miles. The tower had only been finished one week before the accident occurred and the masonry was still green; no water was in the tower at the time, and it's downfall is probably due to this *fact*. Eye-witnesses to the accident state that the upper 25 or 30 feet collapsed during the gale. No charge is made of bad workmanship or inferior material.

The city ordinance authorizing the works simply calls for a water tower of 300,000 U. S. gallons capacity, with foundations of first-class stone masonry.

KANSAS CITY, MO.—The National Water-Works Co., which owns the city water-works has issued a thirty year, 6 per cent. first mortgage loan for $1,500,000, based on the works. The works were built in 1874-75 and the earnings have been used in extending the service on account of the rapid growth of the city. Recently the company purchased the capital stock and works of the Wyandotte and Armourdale Water Co., whose franchise covers Wyandotte, Kansas City and Armourdale in Kansas, which will add materially to its revenue. The net earnings of the company have shown an increase of over 15 per cent. a year and for the current year will be about 25 per cent. in excess of the interest charge. The new bonds, which are held by Taintor & Holt, New York City, are to meet the cost of needed extensions and to change the source of supply from the Kaw to the Missouri river.

THE Hyatt Filter system, now being considered for adoption by the Allegheny, Pa, Water Co, is for a plant of 20,000,000 daily capacity, and not 2,000,000 as stated by a Pittsburg paper. The cost of the plant is estimated at $300 000.

COHOES, N. Y.—The new reservoir has been completed by the contractors, Houlihan & Madigan. It is 660 feet by 600 feet, with a capacity of 80,000,000 gallons, and provision is made for increasing the capacity 5,000,000 gallons when necessary. The pressure on the pipes at the lower end of the city will be 80 pounds per square inch. An additional pump is to be put in.

GRAND RAPIDS, MICH. There is considerable trouble owing to the continual leaking and bursting of the mains. There are two miles of the original log pipe, ten miles of log pipe covered with iron and fifteen miles of iron pipe; most of the leaks are from the second class of pipe, and as the leaks are discovered the pipes are removed and and replaced with iron. In about three years the entire system will be laid with the iron pipes.

As an offset to the late statement in this journal that Dr. Brush had pronounced the water of the New York & Mount Vernon Water Co "unfit for use," we now have the official report of Dr. C. F. Chandler and Edward W. Martin to the following effect: This report is based on personal tests and examination, and the experts say that the statements made that the use of this water is dangerous to public health are not, in their opinion, supported by a single fact in connection with the reservoir or its sources, or any analyses thus far presented. They further state that many of these statements are ridiculous and are made by persons having little, if any, experience in discussing practical questions connected with water supply. The verdict of Prof. Chandler and Mr. Martin is entirely in favor of the water and its sources.

An Inland Water-way.—Surveys are being made for the proposed water-way along the Atlantic coast, in Worcester county, Md., from the head of Synepuxent Bay to Rehoboth. The route will be parallel with the coast and only four and a half miles of excavation will be required to open up 70 miles of navigation. Col. Lemuel Showell, president of the Wicomico & Pocomoke R. R. Co., Berlin, Md., is interested in the project.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The American Exhibition.—It is reported that 150 tons of steel rails have been delivered on the ground for the exhibition in London, to be used for the framework: 1,500 tons will be required.

Omaha Bridge.—A leak was sprung on the 21st inst., in the shaft of the caisson for the middle pier of the new bridge for the Union Pacific R. R. at Omaha, Neb. The shaft was finally bailed out and the hole plugged: 15 men were imprisoned in the caisson for two hours and a half.

Central Pacific R. R.—In consequence of the difficulty in obtaining sufficient wood, the company has decided to use coal for its locomotives. Several passenger engines have already been converted into coal burners, and freight engines are now in the shops undergoing the necessary alterations.

The Kansas City Elevated Railway.—The first trip on this new road was made on October 16th, and the next day it was formally opened to the public with eight trains running. This second "L" road in the United States is 3¼ miles long, single-track. The superstructure in general form is made up of pin-connected steel trusses of about 50 feet span, supported by wrought-iron columns, so says the Kansas City *Times*. The upper chord of the truss is made of two ten-inch steel channels in a single length, connected at 16-inch intervals by U-shaped steel plates riveted to the channels. On each of these U-plates rests an oak-block, 2 inches thick by 4 inches square, serving as a cushion for the rail, which rests directly upon these blocks; as these blocks are sunk between the channels, which are 6 inches apart, the latter serve also as guard-rails. In this manner wood is almost entirely dispensed with. The supporting columns are placed 3 feet from the rails of the surface railway track, one on either side, and rest in heavy cast-iron bases, which are in turn supported by masonry resting on concrete. There are nearly 4,000,000 pounds of steel used in the structure which was built entire by the Edge Moor Iron Co., Wilmington, Del. The steepest gradient on the road is said to be 3 feet per 100 feet. The cars used are about 30 feet in length, seating 40 people: the motors weigh about 15 tons and use coke as fuel. Work was commenced in the summer of 1885: then checked by injunctions for nearly a year, and again commenced this spring. Mr. D. M. Edgerton is president, and Mr. Robert Gillham, chief engineer. The amount expended is stated at $100,000. Mr. Gillham, though still a young man, was also the engineer of the cable-road of Kansas City; and the city press of that place divides the credit of the successful completion of the present undertaking between himself and Mr. Edgerton, the president of the elevated railway company.

Contracting.

Dredging.—The contract for dredging in Breton bay, Md., has been awarded to the National Dredging Co., at Wilmington, Del., at their bid of 11 cents.

New Croton Aqueduct.—John Boardman, an employé who was permanently injured by an accident at Shaft No. 3, of the New Croton Aqueduct, on December 7, 1885, sued the contractors, Brown, Howard & Co., for $20,000. The Supreme Court at White Plains gave him, on October 25, a verdict for $15,000.

Iron.—The contract for iron-work for the sluice gates in the dam at Menasha, Wis., has been awarded to Messrs. Morgan & Bassett, Appleton, Wis., at 3 cents per pound for castings, and 3½ cents per pound for screw bolts.

Stone.—The following are the prices bid per cubic yard for stone for use at the Des Moines Rapids canal and dry dock: Patterson Bros., Keokuk, Ia.; face stone, $10; backing stone, $6; rip-rap face stone, $2.25; rubble filling, 70 cents. The total amount was $21,200.

Levee Work.—Contracts have been let at Vicksburg, Miss., as follows:—Monoa levee, A. P. Martin, 21.5 cents: Lee levee, John McGinty, 22.5 cents: Wylie levee, John McGinty, 20 cents; Reid levee, John Arnold & Co., 27 cents; Ships Bayou and Miller's Field levees, John B. Reid, 27¾ and 15¾ cents. There is a considerable amount of work yet to be contracted for.

Sewers.—The following bids have been received at the Department of City Works, Municipal Building, Brooklyn, N. Y.: 18, 15 and 12-inch cement pipe per foot, and manholes complete with iron head and cover; John S. Bogert, $1.45, $1.30, $1, $34; Edward Gorman $1.40, $1.15, and $1.25, 83 cents, $33; Daniel J. Creem, $1.30, $1.10 and $1.15, 98 cents, $35; John Maguire, no bid, $1.61, $1.09, $39.

Paving.—The following bids have been received at the Department of City Works, Municipal Building, Brooklyn, N. Y., for cobblestone paving:—John J. Hart, $6.37 per lineal foot; Henry Mogk, $5.29; John Hennessy, $5.15; John Maguire, $4.55; James F. Gillen, $4.45.

At St. Paul, Minn., the following prices have been paid during the past year; cedar block, $1.25 per square yard; granite curb, 90 cents per lineal foot; earth excavation, 20 to 25 cents per cubic yard; paving 40-feet roadway, $8 per lineal foot.

The Port of New York.—Lieutenant-Colonel Mcriand, in charge of the river and harbor works in the vicinity of New York, has submitted the following estimate of the amounts of money required to complete the various projects in his care:—

	For next year.	Total estim'd cost of projects.
Hudson River	$35,000	$94,000
Saugerties Harbor	15,000	26,419
Rondout Harbor	7,500	7,500
Harlem River	.....	2,300,000
Newtown Creek	100,600	173,069
Gowanus Bay	50 000	120,064
Buttermilk Channel	50,000	113,750
Sheepshead Bay	10,000	13,100
Canarsie Bay	25 000	55,000
Sumpawanus Inlet	10,000	33,000
Manasquan River	.....	33,000
Shrewsbury River	40,000	40,000
Keyport Harbor	10,000	10,000
Mattawan Creek	.....	12,120
Cheesequakes Creek	.....	50,000
Raritan Bay	75,000	75,500
Raritan River	100,000	622,412
Sout River	25,000	133,695
Woodbridge Creek	.....	10,000
Rahway River	.....	29,250
Elizabeth River	.....	16,160
Channel between Staten Island and New Jersey	35,000	91,000
Passaic River	125,000	181,875

Topeka, Kan., Pavement Report.—The citizens of Topeka, Kansas, preparatory to paving some of its main streets, appointed a committee to investigate the merits of paving generally and the experience in other cities. This committee was composed of Messrs. Gage, Osborn, Jewell, Knowles and Jones, and their report contains a very considerable amount of interesting data relating to experience in street paving. Firebrick, as used in Steubenville, O., and Bloomington and Jacksonville, Ill., was first considered. This pavement was made of two courses of hard-burned brick of ordinary size laid on sand, with the first course flat and the second on edge. Experience shows that this pavement will do well enough for light traffic, with say one hundred teams a day passing over. But the lack of uniformity in the hardness of the brick causes unequal wear.

Macadam was voted as unsuited to their purpose; and they quote the experience of Toronto, Can., Sandusky, Ohio, Cincinnati, New Haven, Kansas City and Omaha as being all against its employment in cities. Their choice lay between sheet asphalt on concrete base and stone block pavement. But in Omaha, Colorado sandstone pavement costs from $2.61 to $2.87 per square yard, with 8-inch deep blocks laid on sand; Sioux Falls granite costs $2.53 on sand, and $3.09 on broken stone and sand. In Kansas City stone block costs as much as in Omaha. While in Topeka, a good sandstone or granite pavement would cost about $3.00 per square yard, laid on 8-inches of sand. Asphalt pavement on a 6-inch concrete base, in 1886, cost in Omaha $2.98 per yard, with a five years guarantee.

In St. Joseph, owing to competition, the price was only $2.63 (and is since lower still). This price includes the grading by the contractor of 9 inches of the street and hauling this dirt, not more than 1,000 feet; a five years' guarantee is also included. The committee taking into account first cost, maintenance, durability noise, wear and tear on vehicles and animals, health cleanliness, cost of keeping clean, etc., recommended the use of standard sheet asphalt, except on one square where the grade was too steep, where they would substitute granite or sandstone block.

Contractors Intelligence,

Reported by T. H. Boorman.

Engineering and Building Materials.

WHOLESALE PRICES.

New York, October 28, 1886.

IRON.

STRUCTURAL IRON.		
Angles	2.15c	@ 2.30c
" steel	2.40	@ 2.50
Tees	2.50	@ 2.60
Beams and channels, American	3.00	@
Tank plates	2.25	@ 2.35
Shell plates	2.50	@ 2.60
Steel plates, Tank	2.70	@ 2.75
WROUGHT-IRON PIPE. PITTSBURG.		
Butt welded, black ..... Discount		42½
" galvanized ..... "		32½
Lap welded, black ..... "		55
" galvanized ..... "		37½
Boiler tubes ..... "		47½
RAILS.		
Steel (large lots at mill)	$34.00 @	$35.00
Old rails	22.00 @	22.50
Old rails, steel	22.06 @	23.00
R R. spikes	2.15c @	2.20c
R R. splice-plates	1.70 @	1.90
R R. track bolts, square nuts	2.50 @	2.75
Barb-wire fencing, galvanized	3.85 @	3.90
" painted		4.00
Corrugated iron		
Nails		
Iron, per keg	2.00 @	2.10
Steel do.	2.10 @	2.20

METALS.

COPPER.		
Lake Superior	11.25	
Other Brands	11.05 @	11.45
LEAD.		
Com. Domestic	4.00 @	40.5
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	5.62½ @	5.70

BRICK.

Cargoes (afloat)		
Choice Brands	8.50 @	9.00
Haverstraw ..... per M.	7.25 @	8.00
Fishkill	7.50 @	7.25
Up-River	7.50 @	7.00
Jerseys	6.25 @	7.00
Long Island		
Pale	4.75 @	5.00
FRONTS.		
Croton, red	13.00 @	15.00
" dark	13.00 @	15.00
" brown	12.00 @	14.00
Philadelphia pressed	27.00 @	28.00
Trenton "	25.00 @	26.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	85.00 @	130.00
" American	80.00 @	120.00
Fire brick	25.00 @	55.00
" American, No. 1	30.00 @	35.00
" " No. 2	25.00 @	30.00

ASPHALT.

ROCK.		
French, per ton	$20.00 @	25.00
German	15.00 @	20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50 @	$3.00

LIME.

Rocklock Cement Co.'s Ground	.80	
Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.85 @	.90
" finishing	1.05 @	1.10
Kingston, ground	.90	

Add 25c. to above figures for yard rates.

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95 @	1.00
" " No. 2 "	0.75 @	0.85
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "		
Brown stone, Portland, Ct. "	1.00 @	1.35
" Belleville, N. J. "	0.75 @	1.35
Granite, rough	0.45 @	1.25
Common building stone per load	2.00 @	3.00
se stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00
oncrete and macadam stone, Tomkins Cove, per cub. yd		$1.65

SLATE.

Purple roofing per square	5 00 @	6.00
Green "	5.00 @	6.00
Red "	10.00	
Black Penna. (at New York) "	3 50 @	4.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00 @	20.00
Choice "	65.00 @	70.00
Tally plank, 1¼ in. 10 in. dres'd, each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	14.00 @	18.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2½ × 4 to 4 × 6 in	.16 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	25.00 @	30.00
Dressed flooring "	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75 @	6.00
LATH, Cargo rate "	2.35 @	2.40

PAINT.

Lead, white, American dry per lb	.04¾ @	.06½
" " " in oil pure	.07 @	.07½
" English, B. B. in oil	.08¼ @	.09¾
" Red, American	.06½ @	.07
Litharge "	05½ @	.06
Venetian red, American "	.01 @	.01¼
Indian red "	.08 @	.10
Vermillion, American lead "	.10½ @	.11½
Paris green "	.15 @	.18
Umber, Amer. raw and powdered per lb.	.01¼ @	.01¾
Drop black, Amer.	.07 @	.13
" " Eng	.11 @	.13
Chrome green	.10 @	.25
Oxide zinc, American	.03½ @	.03¾
" French	.05½ @	.07½

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:		
"Old Newark Co's." Cement		$1.10
BAETJER & MEYERSTEIN:		
Hanover Portland	$2.60 @	$2.65
BELLONI & CO.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
Burham	2.25 @	2.50
Fewen	2.25 @	2.50
BROOKS, SHOOBRIDGE & CO.	2.45 @	2.60
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	2.40 @	2.75
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.50 @	2.75
K. B. & S. "	2.25 @	2.50
Stettiner, German	2.65 @	2.85
Lazerdorfer, "	2.45 @	2.75
Fieve, A 1, Belgian	2.35 @	2.50
Roman	2.75 @	3.00
Keene's Coarse	4.75 @	5.50
" Fine	7.75 @	8.50
" Superfine	8.50 @	10.00
HUDSON RIVER CEMENT CO. Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15 @	2.45
EMIL LENZ, New York.		
Stettin Portland	2.35 @	2.55
Fire-proof	1.75 @	1.95
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20 @	2.40
Improved "Union"	1.25 @	1.50
Union	1.10 @	1.20
NEW YORK CEMENT CO.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT CO.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
Alsen's Portland Cement Works	2.35 @	2.85
K. B. & S.	2.25 @	2.50
STANDARD CEMENT CO		
E. THIELE:		
Dyckerhoff	2.90 @	3.25
UNITED STATES CEMENT CO.:		
English Portland	2.25 @	2.40
German "	2.00 @	2.15
Standard	1.50 @	1.65
Windsor and Improved Rosendale	1.00 @	1.10
UNION AKRON CEMENT CO.:		
Akron "Star" brand	1.00 @	1.10

MARKET SUMMARY.

The Brick Markets is not so active this week and cargoes have moved slowly, the price, however, has been maintained and Choice Haverstraws are still quoted at $8.50@$9.00 per M. Firsts $8.75@$8.00, and Seconds, $7.25@$7.50; Fishkill command $7.25@$7.50 per M., and other Up-Rivers, $7.00@$7.50 per M.; Philadelphia and Trenton fronts are in fair demand at last week's prices. Rosendale Cement is in very active request, and large sales have been made at $1.10 per barrel; Lime moves in good quantities at $1.00 per barrel for Common Rockland: $1.20 for Finishing; State sells at 85c.@90c. per barrel for Common; $1.05@$1.10 for Finishing; Hair is very scarce, and best quality of Goat is worth 35c.@36c. per bushel; Plaster sells at $1.20@$1.25 per barrel for ordinary City, with a good demand for home and export consumption. The Lumber Market continues steady in prices, and no feature is particularly noticable, with the exception of an improved demand for special schedules of Spruce Timber which fetch as high as $18.00 per M., with ordinary random cargoes at $14.00 per M.; Yellow Pine, $18.00@$21.00 per M.; Lath in good request at $2.35 per M., with some sales reported at $2.40 per M. Paints and Oils are about as last week; Western Linseed Oil has been sold at 39c. per gallon, and City at 41c. per gallon; Turpentine is firmer and is quoted at 39c. per gallon. Lead has been sold in quantities at 4c.@4 05c. per lb., with the former closing quotations. Transactions in Tin have been light. The Foreign Market has been irregular; Straits are quoted 22½c. for ordinary store parcels; Tin Plates have been in limited demand, and the market not considered firm at the rates of $4 60@$4.65 for Allaway, and $5 15@5.20 for Melyn grade. I. C. Charcoal, ¼ cross-assortment. The Hardware Market does not yet show any marked signs of activity; manufacturers are endeavouring to stiffen prices to compensate for the increased cost of raw material, but the demand hardly allows of any improvement, and Nails are reported sold at $1.95@$2 05 for 10d. @60d., according to size of invoice. Pitch and Tar are in fair request, and sell at $1.50@$1.70 per barrel for Pitch, and $1.90@$2.40 for Tar, according to quantity and quality. We hear that steps have been taken by Glass Manufacturers to establish a national syndicate to advance and maintain the price of window glass.

BUILDING ITEMS.

Messrs. Schwarzmann & Buchman have prepared plans for a five-story brick store, 74.8x129.6, to be built on the southeast corner of Third avenue and 125th street for Mr. Louis Ranger, at a cost of $130,000.

Plans have been filed for the building, previously mentioned, to be built for the Y. M. C. A. on the north side of 125th street, 120 feet west of Tenth avenue, the cost will be about $75,000. Mr. Bradford L. Gilbert is the architect and Chas. A. Cowen has the contract for the mason work. Plans have also been filed for the "Vanderbilt Clinic" Building, to be built in connection with the College of Physicians and Surgeons on the southeast corner of Tenth avenue and Sixtieth street, the building is to be of granite and brick, 60x160, and will cost about $130,000. Mr. W. Wheeler Smith is the architect and John J. Tucker the mason builder.

Mr. Samuel A. Warner has designed a two-story brick church, 50x80, to be built for the Church Extension Committee, of the Presbytery of New York, on the north side of Sixty-second street, 155 feet west of Second avenue, to cost about $20 000. Messrs. J W. Hogencamp & Son have been awarded the contract.

The plans of Messrs. McKim, Mead & White, 57 Broadway, have been accepted for the new building, to be erected by the Freundschaft Club on the southeast corner of Seventy-second street and Fourth avenue. The buiding will be three stories high, 102x130, of stone and brick and will cost about $200,0.0.

Mr. John C. Burne has drawn plans for five five-story brick and stone appartment houses, 25x60, to be built on the southeast corner of Ninth avenue and Ninetieth street for Mr. Thomas Gearty at a cost of $100,000.

Mr. Emile Grewe has prepared plans for altering No. 305 West Fourteenth street to a flat, at a cost of $7,500.

Mr. W. P. Anderson has designed fifteen three-story brick dwellings, to be buil tby Mr. P. J. O'Brien on Edgecomb avenue and 145th street, at a cost of about $120,000.

Mr. Chas. T. Mott is the architect for alterations to be made to the residence, No. 1310 Fifth avenue for Mr. O. D Munn, to cost $6,000.

Messrs. J. C. Cady & Co. have prepared plans for two two-story frame dwellings, to be built at a cost of $12 000 on 184th street, near Andrews avenue, for Mr. Wm. D. Peck. Messrs. C. Fohn & Son are the contractors.

Mr. Joseph Wolf has designed for Mr. John Eusner a five-story brick tenement, 25x65, to be built at No. 510 West Forty-eighth street, at a cost of $16,000.

Mr. Alfred E. Barlow, 149 Broadway, is the architect for a two-story and attic dwelling, to be built on the northwest corner of 184th street and Andrews Avenue for Mr. Thos. Haddock, to cost $6,000.

On the south side of Seventy-sixth street, 200 feet east of Tenth avenue, six four-story and basement brick dwellings, 20.10x55 are to be built for Mr. Justus J. Smith, at a cost of $150,000 from designs of Messrs. DeMouron & Smith, 62 Cedar street.

Mr. John G. Prague has drawn plans for a four-story brick and stone store building, 22.11x65, to be erected at No. 275 Bowery for the Marsh estate, at a cost of about $14,000.

Messrs. A. B. Ogden & Son have prepared plans for a five-story brick and stone apartment house with stores on first floor, 3 6x82, to be built for Mr. John David.on on the north side of Christopher street, 113 feet south of Waverly Place, at a cost of about $40,000.

Mr. Charles Rentz has on the boards designs for a six-story tenement, 25x90, to be built at No. 101 Norfolk street for Messrs. Chas. and A. Ruff, at a cost of $18,000.

Messrs. Wm. H. Merserean and John A. Hamilton have made plans for two three-story, brick and terra-cotta offices and stores, to be built for Mr. J. M. Dearborn at Mount Vernon, at a cost of $10,000.

NATURAL GAS.—At Kokomo, Ind., a company has been organized to bore gas and oil wells; capital stock, $100,000; President, Hon. James F. Elliott; secretary, John S. Stringer.

At Rochester, Ind., a company with $2,000 capital has been organized to bore for oil or gas. The company proposes to secure the old well driven by the city to a depth of 500 feet and will extend it until oil or gas is reached.

THE HYATT FILTER.—City engineer Albert Davidson, of Augusta, Ga., has examined the Hyatt system of filtering water and thinks favorably of it. It has been proposed to put in a plant to filter a supply of 6,000,000 gallons per day of river water; the water is said to be very pure in quality but is not free from mud.

STEEL WORKS.—Judge Cunningham, of Atlanta, Ga. a director of the Bartow Mining and Manufacturing Co., is desirous of corresponding with parties who contemplate the erection of steel works, with regard to locating them at Atlanta. The Bartow Company owns over 2,000 acres of good mineral lands, and rich manganese mines; the product of which is now sent to Pittsburg steel manufacturers. The company would make liberal arrangements to supply ore to manufacturers at Atlanta.

RAILROAD PONTOON BRIDGE.—John Lawler's new railroad pontoon has been successfully launched at Prairie du Chien, Wis.: it is 460 feet long, 40 feet wide, contains over 1,000,000 feet of lumber, and cost $45,000. It is to carry the Chicago, Milwaukee & St. Paul R. R. over the east channel of the Mississippi at Prairie du Chien.